

**SAN JUAN RIVER  
SEVEN YEAR RESEARCH PLAN  
(FISCAL YEAR 1992)**

Prepared by:  
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## San Juan Ichthyological Investigations

### WORK STATEMENT/PROTOCOL

#### HABITAT/FLOW RELATIONSHIPS

##### Background:

Habitat availability at different flows is an important facet of the overall research plan which seeks to determine the biological response of target species to more "natural" flows in the San Juan River. Determination of habitat/flow relationships is integrally related to other ongoing research which deals with habitat use by target species. Riverine habitats must be quantified in order to determine the relationship between habitat availability, habitat use by target species and the impact of flows on target species.

Airborne videography has proven useful for determining habitat to riverflow correlations on several rivers in the upper and lower Colorado River basins. Airborne videography provides a cost effective method for long term monitoring of habitat changes over time and with different flows.

##### Methods:

The study area chosen for habitat mapping using videography is the San Juan River from the Hogback diversion near Farmington, New Mexico to Mexican Hat, Utah. During FY91 the river was filmed five times to determine changes in riverine habitat related to different flows. Video was acquired once prior to spring runoff, once during the peak runoff, and three additional times as the flow subs.

Video of the San Juan River was acquired using a 3/4 inch CCD video camera mounted to a Tyler mount on the nose of a helicopter. The helicopter utilizes a radar altimeter to maintain a constant altitude of 2,000 feet above the river which provided coverage of the entire river width for the majority of the reach. Widely braided areas were filmed using two passes. Using an altitude of 2,000 feet above ground level yields a resolution of approximately one meter. The video imagery is interpreted using MIPS (Map and Image Processing System), a PC based digitizing image software. Several bridges along the reach have been measured to provide a calibration standard for measurements done with the computer. Individual frames of the video are grabbed by the computer to be analyzed by the investigator. Using the software, each portion of river contained in a frame is categorized and delineated by a polygon that yields the area of a feature. The data will be interpreted for the following categories; backwaters, side channels, isolated pools, main channel and total open water. Abutting frames of the entire study reach will be analyzed using this methodology. The resulting numerical data will then be evaluated for habitat to flow relationships using spreadsheet software and statistical methods.

During FY 1992 video data collected during 1991 will be interpreted using MIPS. A report will be generated in early March that will include tabular data giving acreage and number by river mile for the following categories: backwaters, side channels, isolated pools, total open water.

Also in FY 92, the data acquisition schedule of the previous year will be repeated to verify the flow habitat relationships developed with the first year's field data. In addition, an attempt will be made to collect video imagery of winter habitat conditions.

Animas River has been the major source of spring runoff flows in the lower San Juan River system. Tributaries downstream of the Animas contribute little to the total volume of the San Juan River.

Ichthyofaunal surveys prior to extensive European settlement of the basin were very limited. However, early and subsequent surveys which are reviewed by Platania (1990) were sufficient to document a native fish fauna of nine species in the San Juan River. Eight species, Cutthroat trout (Oncorhynchus clarki), roundtail chub (Gila robusta), Colorado squawfish (Ptychocheilus lucius), speckled dace (Rhinichthys osculus), flannelmouth sucker (Catostomus latipinnis), bluehead sucker (Catostomus discobolus), razorback sucker (Xyrauchen texanus), and mottled sculpin (Cottus bairdi) were all known by 1960. An additional species, bonytail chub (Gila elegans) had been suggested as a possible member of the native ichthyofauna, but its occurrence was not confirmed until 1991. Steven P. Platania (pers. comm.) examined museum specimens and found two individuals collected prior to 1941 thought to be G. robusta, were G. elegans. The limited nature of the surveys undertaken does not permit quantitative or even qualitative estimates of the abundance of any species. However, the size range of specimens, distribution of species collections and accounts by local residents strongly support the contention that each species had reproducing and viable populations in the San Juan River drainage.

The San Juan River was largely ignored as a native and endangered fish resource in the years between 1960 and 1987. This was due to factors such as the fish poisoning project below the newly constructed Navajo Reservoir which was assumed to have eliminated or reduced endangered fish populations, relatively dense human settlement along the river near Farmington, in New Mexico, relatively large water depletions, and the degraded water quality in accessible areas associated with human activities. In addition, the remoteness of many parts of the river discouraged intensive or thorough studies of the river. The most significant native fish surveys of the San Juan River during this period include Olsen's preimpoundment study of Navajo Reservoir (Olsen 1962), Sublette (1977) and VTN Consolidated Inc., and Museum of Northern Arizona (1978). Despite the limited nature of these collections, the persistence of the native fish fauna in recent years was documented by the collection of all species found prior to 1960 with the exception of bonytail chub.

The first comprehensive study of fisheries in the San Juan River was initiated in 1987 when a three year study was implemented to obtain a more accurate characterization of the native fish fauna. The study, although encouraged in the 1979 biological opinion associated with the proposed Animas-La Plata project, was prompted by a proposal to re-establish the razorback sucker in the San Juan River. The study confirmed that Colorado squawfish persist and reproduce in the San Juan River, and that the razorback sucker also

occur and may reproduce (Platania 1990). In addition, state listed species of concern such as roundtail chub still occur (reproduction documented, but no adults captured). The study also documented a fairly intact native fish community with all of its historic elements except for the bonytail chub. The non-native fish community in the river consisted of several species that are relatively widespread and common. Relative abundance and composition of the non-native species, however, was different than that reported for other upper basin Colorado River basin streams. The most noteworthy and significant differences may be the paucity of centrarchids and absence of northern pike (Esox lucius) and walleye (Stizostedion vitreum).

**PURPOSE AND NEED.** Animas - La Plata is a proposed water development project which could ultimately deplete up to 154,000 acre feet of water from the Animas and La Plata Rivers. Concerns have been raised that diversion of water from the Animas River could potentially impact endangered fish species in the San Juan River. A 1979 biological opinion for the Animas - La Plata project concluded that the project would not impact the endangered Colorado squawfish in the San Juan due to the apparent small size of the population in the San Juan river. Subsequently the importance of the San Juan River basin was re-evaluated based on new evidence. The revised biological opinion for the project resulted in a jeopardy finding for the Colorado squawfish which is a listed endangered species and the razorback sucker which is proposed for listing. The revised biological opinion, however, also contained a reasonable and prudent alternative for the project. Elements of the Reasonable and Prudent Alternative applicable to the research program include:

1. A commitment by Reclamation to fund approximately seven years of research on the San Juan River and its tributaries in conjunction with research on the impact of flows from Navajo Dam. Research emphasis will be directed towards observing a biological response in the endangered fish population and habitat conditions as a result of altered flows. This research would be conducted by knowledgeable endangered species and habitat experts and would allow for testing of hypotheses. The ultimate goal of the research would be to characterize those factors which limit native fish populations in the San Juan River and to provide management options to conserve and restore the endangered fish community. Approval of the study design would rest jointly with the Service and Reclamation.
2. Reclamation will operate the Navajo Dam for the seven year research period under guidelines developed by the research program. Test flows will be provided to re-create a wide range of flow conditions including high

flows similar to 1987, which are hypothesized to benefit reproduction and recruitment of the endangered fish community. Release schedules would be determined by the Service and Reclamation based on research needs and the available water supply after meeting baseline depletions. Water releases would be subject to limitations of the outlet works facilities and safe routing of hydrological events in the upper Colorado River basin.

As a result of the Reasonable and Prudent Alternative for the Animas-La Plata Project and the need to study the biological impact of the reoperation of Navajo Dam during the seven year research period, the Bureau of Reclamation and the U. S. Fish and Wildlife Service agreed to devise a multi-year research plan. The research is designed to provide the information necessary to recover endangered fishes in the San Juan River and assess proposed future water depletions.

#### **RESEARCH PLAN**

A large array of research needs for the San Juan River and its native fish community have been previously identified in meetings, correspondence, memoranda, draft research outlines, reports, and journal publications. All, in varying degrees, seek to obtain and evaluate data that are believed necessary to conceive, design, and implement strategies to conserve the native fish fauna of the river. The sheer extent of these, coupled with the comparative paucity of actual knowledge of factors influencing populations of native fishes in the San Juan River drainage, requires development of a hierarchical research approach. Thus a well defined continuum of research efforts is required that clearly maps activities, but which allows modification of specific research programs as new information is obtained. A basic concept of the proposed program is to consider the entire fish community, native and non-native species, with particular emphasis on Colorado squawfish, bonytail chub, roundtail chub, and razorback sucker (target species). In addition, because of the high public interest and concern, the trout fishery associated with the Navajo Dam tailwater also requires research attention to evaluate its response to different flow regimes.

A seven year research plan was devised by a team of biologists representing the U. S. Fish and Wildlife Service (Service), Bureau of Reclamation (Reclamation), New Mexico Game and Fish Department (NMGF), Utah Division of Wildlife Resources (UDWR) and the Colorado Division of Wildlife (CDOW). It was developed to facilitate implementation of elements of the Reasonable and Prudent Alternative for the Animas-La Plata project, specifically the formulation of a seven year research plan and development of the proposed test flows from Navajo dam for the research period.

## **GOALS/OBJECTIVES**

The ultimate goal of the research is to determine the physical, chemical and biological factors which are limiting for native fish populations in the San Juan River and to provide management options to conserve and restore the endangered fish community.

Specific objectives of the Research plan include;

1. Collect detailed information on the relative abundance and distribution of fisheries in the San Juan River basin, with emphasis on areas downstream of Navajo Dam.
2. Characterize physical habitat for fisheries in San Juan River and the relationship between flow and physical habitat.
3. Determine the biological response of fish populations to the reoperation of Navajo Dam.
4. Determine habitat use and needs of the Colorado squawfish in the San Juan River.
5. Determine habitat use and needs of razorback sucker in the San Juan River.
6. Characterize water quality in the San Juan River and identify critical quality issues which may affect recovery of endangered species.
7. Identify interactions between native and non-native fisheries.
8. Identify and test management options which could improve reproduction and recruitment of target species.

## **APPROACH**

The Seven Year Research Plan has two basic components, Core Research Programs and specific hypothesis related studies. Core Research Programs are long term studies (3-7 years) which are designed to measure the natural variability of fish populations and the biological responses of the San Juan River system to changes in flow over the seven year research period. Core programs involve systematic research programs which extend for three or more years so that relative changes in populations can be detected and related to flow or other events. The long term Core Research Programs are an indispensable component of the research necessary to measure the biological response of the endangered fish fauna to the reoperation of Navajo Dam during the research period as required in the Reasonable and Prudent Alternative for the Animas-LaPlata Project. Hypothesis testing studies are studies which will be specifically

designed to answer questions raised by ongoing research and address issues not covered by the core program. These studies would generally be shorter term projects (1-3 years).

The Seven Year Plan would be executed in three phases with the cooperating agencies assuming responsibility for conducting various aspects of the research.

In Phase I (FY 1991) several key research efforts involving long term core research programs were implemented and design and logistical issues resolved. Critical Core Research Programs which were initiated in Phase I included: Adult monitoring/telemetry, Early Life History research, Secondary Channel studies, and Habitat/Flow studies. These studies will be conducted for the entire seven year research period, and used as a baseline index against which relative population changes can be measured over the seven year research period. Objectives of Phase I included:

- help refine capture techniques,
- define abundance and distribution of target species in the San Juan River,
- locate target species aggregation areas and spawning and nursery areas,
- characterize physical habitat,
- acquire tissue from target species for genetic analyses,
- review and compile available information of San Juan River water quality and,
- identify critical water quality parameters.

Phase II (FY 1992-1994) will involve implementation of some additional core research and continuation of existing Core Research Programs. Studies will also be completed which will more precisely define the status of species of concern and identify critical habitat areas for each target species. In Phase II studies will be initiated to: 1) identify and quantify limiting factors, 2) determine environmental requirements of the resident ichthyofauna; and 3) measure responses of species of concern to experimental flow regimes.

Phase III (1994-1997) will involve continuation of the Core Research Programs which were initiated in Phases I and II, testing of specific hypotheses developed in the initial phases, and monitoring effects of conservation measures that may be instituted. Study designs for Phase III will be refined and implemented based on findings in Phases I and II.

## FLOW RECOMMENDATIONS

Reoperation of Navajo dam to mimic a natural hydrograph and provide test flows is an integral part of the proposed research. Test flows during the 7-year study of the San Juan River will allow researchers to determine the best flow regime for preserving and recovering listed fishes. **Research flows will be established primarily to test the effect of the magnitude of spring peak flows on spawning, larval production, and habitat (quantity and quality).** In addition, flows will be established for other periods based upon current knowledge of the various life stages of these fishes.

The spring research flows scenarios to be evaluated will be based on historic flow levels. The scenarios to be evaluated include at least one low water year, however, emphasis will be on mimicking a historical hydrograph of normal to high magnitude. Proposed spring release schedules include;

- 1) During a year when spring peak flows from the Animas River are forecasted to be near normal, Navajo Dam will attain a peak release of approximately 4,500 cfs duplicating both timing and duration of a typical historic hydrograph for the San Juan River during a normal precipitation year.
- 2) During a year when spring peak flows from the Animas River are below normal, spring releases from Navajo Dam will be between 500-2,000 cfs to mimic a dry year hydrograph.
- 3) During the remaining 4 years spring releases from Navajo Dam will mimic the Animas River hydrograph in regards to timing and duration. A minimum spring peak of from 3,000-4,500 cfs will be provided each year to ensure a relatively high spring flow.

The timing and duration of the spring peak should match that of the Animas River. Releases should be increased to coincide with the beginning of runoff from the Animas River and be periodically stepped up to match the ascending arm of the hydrograph until peak discharge is attained. Likewise, following peak flows releases should be stepped down concurrent with the descending arm of the Animas River hydrograph.

Flows during the summer and autumn will remain low and stable (similar to the natural hydrograph) to maximize nursery areas and other low velocity habitats required by the rare fishes. However, test flows will be required during certain summers to examine formation, quantity, quality, and distribution of backwaters and secondary channels.



Winter flows will follow the historic pattern of flows with a minimum flow of about 600 cfs (daily average) measured at Bluff, Utah.

The spring test flows listed above are not presented as a sequence or by priority, but, a recommendation that all the above flows be tested as the necessary hydrologic conditions become available. Flow releases from Navajo Dam for a given year will be set during March of each year prior to spring runoff. The U.S. Bureau of Reclamation will set flows after consultation with cooperating researchers. Flow releases will be based on to a large degree on research needs, but will be subject to projected snowpack and water yield and legal and flow routing constraints.

#### DATA MANAGEMENT

Due to the extensive nature of the proposed research it will be necessary to establish a data management system which include quality control and assurance procedures and a central data base for all researchers who need to access data from other ongoing projects.

New Mexico Department of Fish and Game will coordinate formulation of data sheets so that all necessary information is being collected. Each agency will submit to NMGF their proposed data collection sheets and a list of information required from the other sampling programs necessary to their ongoing research. The data collection sheets will be reviewed for consistency and modified as necessary. For example, much of the information needed for the non-native fish research will be collected in conjunction with other research activities, which may require some modification or expansion of the types of data being collected by the various sampling efforts. In addition, NMGF in conjunction with other agencies will develop a field data management protocol to ensure that all necessary data is collected in the field and is properly recorded.

U.S. Fish and Wildlife Service, Region-2 (FAO) will be responsible for maintaining a centralized data repository in Albuquerque, New Mexico. The USFWS will establish computer data management protocols and be responsible for maintaining the central data repository. The agency will coordinate with all researcher in determining what types of data and its format is appropriate for archiving at a central location.

## PROPOSED RESEARCH FY 1992

Research proposed for FY 1992 is organized into nine categories which constitute the beginning of Phase II. Each category contains a variable number of specific tasks or studies and includes both ongoing and new studies. Research categories for Fiscal Year 1992 include;

- 1) Adult monitoring/Radio Telemetry (abundance, distribution and habitat use and needs),
- 2) Early life history research (abundance, distribution and habitat use and needs),
- 3) Secondary channel ichthyofaunal characterization
- 4) Augmentation studies,
- 5) Ichthyofaunal surveys of tributary streams,
- 6) Navajo Dam tailwater fisheries studies,
- 7) Water quality/Contaminants review
- 8) Non-native fish research, and
- 9) Habitat/flow relationships

Research tasks or studies within each category proposed for FY 1992 are presented in the following section. Detailed research protocols for each of the nine categories are delineated in Attachment A. Budgets for each agency are given in Attachment B.

### CATEGORY - ADULT MONITORING/RADIO TELEMETRY

Status: Ongoing Core Research Program

Lead Agencies: U. S. Fish and Wildlife Service - (responsible for work in San Juan River from Shiprock to Mexican Hat)

Bureau of Reclamation - (responsible for extreme upper end of San Juan arm of Lake Powell up to Slickhorn rapid)

Tasks:

- Adult sampling trips in San Juan River for collection of distribution and abundance data, habitat information and tissue for genetic assessment of stocks of endangered fish.
- Radio implants of adult Colorado squawfish and razorback suckers
- Monitoring of radio-tagged fish with assistance

from other agencies

**Timeline:** Planned for Phase I and II (FY 1991 thru 1994).  
Some tasks may extend thru Phase III as needed

**Objectives:**

- To define abundance and distribution of the native and non-native fish community with emphasis on adult Colorado squawfish, roundtail chub, and razorback sucker (target species)
- Locate potential spawning areas of target species
- Determine seasonal habitat use and needs of target species

**Research Need:** Prior to 1987, irregular sampling efforts had documented a native San Juan River fish fauna of eight species and a possible ninth, including Colorado squawfish, razorback sucker, and roundtail chub. Although not confirmed in the literature, the ninth species (bonytail chub) was found to be a historic component of the fish fauna after reexamination of museum specimens (Platanía 1991?). Surveys during 1987-1989 confirmed the persistence of the Colorado squawfish, razorback sucker, and roundtail chub.

Despite confirmation of survival of Colorado squawfish, razorback sucker, and roundtail chub in the San Juan River questions remain regarding the overall range, boundaries of primary ranges (residency or non-residency in the San Juan River), location of spawning and nursery habitats, and abundance.

Research in other upper basin rivers of the Colorado River drainage and preliminary findings from studies conducted in the San Juan River in 1991 have shown that tracking radio-tagged fish can result in location of aggregations of the target species (particularly Colorado squawfish) during certain seasons and determination of spawning areas.

**Methods:** Three intensive sampling efforts for adult and juvenile fish will be conducted on the San Juan River between Shiprock, New Mexico and Mexican Hat, Utah. Two trips will be conducted during the spring and one during the fall, and will consist of a minimum of nine to ten people from the cooperating agencies.

Collections will be made using a variety of techniques, including; electrofishing, trammel netting, block and shock, drifting trammels, scare and snare, and other applicable methods. Native fish collected will be measured and released. Endangered species will be weighed, measured, PIT tagged, and implanted with radio transmitters if fish are of sufficient size to accept a transmitter. In addition, habitat data and tissue for genetic analyses will be collected from target species.

Subsequent to implantation of radio transmitters the Service will organize tracking trips (with participation from cooperating agencies)

A similar effort will be conducted in the lower San Juan River and upper San Juan arm of Lake Powell under the lead of Reclamation.

#### CATEGORY- EARLY LIFESTAGE RESEARCH

Status: Ongoing Core Research Program

Lead Agency: Utah Division of Wildlife Resources

Tasks: Larval drift sampling  
Distribution of larval and YOY fish  
Overwinter survival of young fish

Timeline: Duration of research program, Phase I-III

Objectives: Determine annual Colorado squawfish YOY recruitment (i.e. reproductive success) in relation to yearly flow patterns in the San Juan River

Identify timing and location of Colorado squawfish spawning in the San Juan River utilizing size and distribution of drifting larvae

Characterize the early life stage ichthyofaunal community in low velocity habitats

Estimate the relative influence of larval emigration on the squawfish population in the San Juan drainage.

Determine the relationship between over-winter survival and flow patterns in the San Juan River

**Research Need:** Early life history investigations are important for determining spawning and recruitment of target species and the potential effectiveness of some management options. Research in the upper basin of the Colorado River has indicated a link between flows and successful recruitment of endangered fish. This relationship needs to be quantified for the San Juan River to effectively manage flow releases for endangered fishes.

**Methods:** Drift netting for larval fish will be conducted daily at two locations in the study area between June 15 and August 15. Three seining trips sampling larval distribution of fish will be conducted concurrent with drift sampling to sample low velocity habitats for larval and YOY fish. Overwinter survival of fish will be determined by conducting two sample trips to compare relative densities of fish in fall and spring samples in low velocity habitats

#### CATEGORY- SECONDARY CHANNEL ICHTHYOFAUNAL CHARACTERIZATION

**Status:** Ongoing Core Research Program

**Lead Agency:** New Mexico Dept. of Game and Fish

**Task:** Characterization of faunal assemblages and physical habitat in secondary channels.

**Timeline:** Phase I and II (FY 1991 thru 1994)

**Objectives:** Characterize type and extent of secondary channels in the San Juan River.

Characterize faunal assemblages of secondary channels,

Determine seasonal use patterns of secondary channels by target species.

Relate habitat use and availability of secondary channels to flow levels.

**Research Need:** Ichthyofaunal sampling in the San Juan River during the last five years has concentrated primarily on main channel and backwater habitats. Secondary channels, however, are a significant component of the habitat in the San Juan River between Shiprock, New Mexico and Bluff, Utah. Cursory sampling of

secondary channels has indicated that fish communities may be different than main channels.

The purpose of the Secondary Channel study is to document species present, their relative abundance, size range (life stage), macro-habitat associations, and seasonal use patterns.

**Methods:** The study is an ongoing three year field effort slated for completion in 1993. Secondary channels have been tentatively classified according to length and flow and will be sampled and characterized according to their fish fauna, macrohabitats, and water quality.

Methods for fish collections will be similar to mainstem efforts. However, due to the habitat being sampled collections will be made primarily with seines. Other methods such as electrofishing and passive netting will be used when appropriate. Fish collected will be identified, weighed and measured. Target species collected will also be tagged and have tissue removed for genetic analysis. Radio transmitters will be implanted (if feasible) according to established procedures.

#### CATEGORY- AUGMENTATION STUDIES

**Status:** Proposed investigation

**Lead Agency:** Fish and Wildlife Service, Region 2 (Fisheries Assistance Office)

**Tasks:** Feasibility study - Neutering of adult, hatchery-reared Colorado squawfish for use in San Juan River telemetry studies.

**Timeline:** Phase II (FY1992-1994)

**Objectives:** Determine if hatchery raised Colorado squawfish can be sterilized to prevent spawning without altering physiology and/or behavior.

Ascertain if Colorado squawfish can be acclimated to natural conditions in a hatchery.

**Research Need:** At present it is unclear whether there are sufficient numbers of endangered fish in the San Juan River to detect a biological response to flow manipulation. The use of artificially produced progeny from wild stocks of San Juan River fish may

be a suitable option for investigating the biological response of endangered fish to different flow regimes. However, if augmentation is to be used to assist research efforts an approved augmentation plan for the San Juan River basin will be necessary to guide use of hatchery raised endangered fishes to accomplish research objectives as well as recovery goals. Implementation of a full scale augmentation plan within the seven year research period may not be possible or desirable.

A alternative recommendation would be to use hatchery-raised, sterilized fish in radio telemetry studies to assess movements and habitat use and to locate more wild fish.

**Methods:** Adult Colorado squawfish (1981 year class) spawned at Willow Beach National Fish Hatchery and presently held at Page Springs State Fish Hatchery would be used for this study segment. During the fall of 1991, experimental fish will be sterilized by severing the posterior attachment sites for ovaries and testes. Experimental and control fish will be held over winter in a recirculating raceway system at Willow Beach NFH to provide current conditioning and to acclimate to a more natural diet. Experimental fish would be examined for reproductive condition, and if incapable of reproducing, recovered and held in the raceway for potential future use. Use of the experimental fish would depend on the numbers of wild adult squawfish collected during the fall of 1991 and spring/summer of 1992.

#### CATEGORY- TRIBUTARY ICHTHYOFAUNAL SURVEYS

**Status:** Proposed investigation

**Lead Agencies:** Utah Division of Wildlife Resources (Tributary streams in Utah)

New Mexico Dept. of Game and Fish (Tributary streams in New Mexico and Colorado)

**Task:** Ichthyofaunal survey of perennial tributaries of the San Juan.

**Timeline:** Phase II (FY 1992-1994)

**Objectives:** To thoroughly inventory the fish community in the warmwater reaches of the Los Pinos, Piedras,

Navajo, Animas, La Plata, and Mancos Rivers in Colorado and New Mexico, and McElmo Creek, Recapture Creek, Montezuma Creek, and Chinlee Wash in Utah.

**Research Need:** The historic and current fish community of the tributaries to the San Juan is poorly documented. No tributary has been systematically inventoried to accurately define species present, their longitudinal distribution, or relative abundance. Knowledge of the faunal composition of the tributaries is important to understanding their interaction with the mainstem river and their relationship to the basin.

**Methods:** Streams will be sampled at three to five km intervals from their confluence with the San Juan upstream to reaches which do not support fish or sustain only salmonids. Where possible historic collection sites will be sampled. Collection techniques will include any combination of electrofishing, trammel nets, gill nets, seines or other sampling technique. The field work will be conducted over a two year period (1991-1993).

#### CATEGORY- NAVAJO DAM TAILWATER STUDIES

**Status:** Proposed Core Research Program

**Lead Agency:** New Mexico Dept. of Game and Fish

**Tasks:** Trout population studies  
Tailwater water quality study  
Angler use and catch surveys  
Trout habitat study  
Trout reproduction study  
Macroinvertebrate study

**Timeline:** Phase II and III (FY 1992-1997)

**Objectives:** Document seasonal and longitudinal distribution of salmonids in response to various flow releases from Navajo Dam.

Determine the relationship between flows from Navajo Dam and survival, growth and condition of salmonids in the tailwater fishery.



Characterize changes in water quality that result from changes in flow from Navajo Dam.

Determine if changes in angler use and catch rates occur as a result of the reoperation of Navajo Dam.

**Research Need:** Changes in release patterns from reservoirs have been known to affect the habitat and water quality and thus fisheries of reservoir tailwaters. Because of the high public interest and concern, the trout fishery associated with the Navajo Dam tailwater requires research attention to evaluate its response to different flow regimes proposed under the reoperation of Navajo Dam.

**Methods:** Research into six different aspects of the tailwater fishery below Navajo Dam are proposed. Three studies encompassing trout populations, water quality and angler use and catch would be implemented by the NMGF. Studies quantifying trout habitat, reproduction, and macroinvertebrate responses to the reoperation of Navajo Dam would be contracted out.

Trout population studies conducted by NMGF would involve mark and recapture estimates of trout populations and analyses of fish movements using PIT tagged and radio tagged fish and collection of scale samples to assess growth rates of trout. Information from the recapture of PIT tagged fish will be used to help verify growth, survival and movement assessments of trout populations.

Two sampling effort will be made in 1992. Fish will be collected utilizing electrofishing just prior to experimental releases in the spring and again during low stable summer flows.

The trout population study is currently planned to extend through the remaining six years of the research period. Data obtained at different flows and observed changes in the fishery will provide information necessary to determine if recommended flows are suitable for trout populations.

Water quality and angler use and catch surveys would also be conducted in conjunction with the trout population studies. Monthly water samples and samples during changing flows would be taken in the tailwater reach below Navajo Dam to determine if any water quality problems occur in the reach as result of the reoperation of Navajo Dam. Water

quality data would be collected for one to two years unless the information collected indicated the need for further evaluation of water quality in the tailwaters.

Standardized pressure count and creel census data would also be collected to evaluate the effect of the reoperation of Navajo Dam on angler use. The data would also be used to supplement population estimate. Angler use and catch surveys would continue through the remaining six years of proposed research.

Contractual studies on trout habitat and reproduction and the macroinvertebrate populations in the tailwater reach have not yet been refined and may ultimately be conducted internally by the cooperating agencies. However, these studies will focus on the response of trout populations to the different experimental flow regimes proposed for Navajo Dam.

#### CATEGORY - WATER QUALITY

**Status:** New investigation

**Lead Agency:** Bureau of Reclamation, Upper Colorado regional office

**Task:** Characterize water quality in the San Juan River basin.

Identify critical water quality issues which may affect recovery of endangered fish in the San Juan River basin.

Coordinate objectives and research efforts of the San Juan Seven Year Research Plan with other on going and planned water quality investigations in the San Juan River basin.

**Timeline:** Initial review of water quality would be conducted during Phase II in FY 1992. Water quality investigations and coordination with other projects and agencies would continue for the duration of the research program.

**Objectives:** Summarize water quality data available for the San Juan River

Analyze available water quality information and identify critical water quality issues which may

affect recovery of endangered fish in the San Juan River.

Recommend additional research that is needed to identify water quality impacts on endangered fish in the San Juan River.

**Research Need:** The Department of Interior (DOI) Water Quality Program is finding potentially significant water quality problems from numerous trace element sources and hydrocarbons in the San Juan River basin. The potential impact of water quality on recovery of endangered fish in the San Juan needs to be characterized.

**Methods:** The DOI has at least four major water quality programs ongoing in the San Juan River drainage. In addition, the U.S. Geologic Survey and the U.S. Environmental Protection Agency are conducting studies in the basin. Water quality data from all available sources will be collected and compiled so that an assessment of its impact on recovery of endangered fish can be made. This review of the available information will be used to identify crucial water quality issues affecting San Juan River fisheries and to make recommendations concerning future research needs. Recommended water quality studies will be integrated into the seven year research plan.

#### CATEGORY - NON-NATIVE FISH

**Status:** Proposed Core Research Program

**Lead Agency:** U. S. Fish and Wildlife Service - Region 2

**Task:** Determine the impacts of predation by nonnative predators and commonality in resource use between native and nonnative fish species under differing flow scenarios.

**Timeline:** Phase II (FY 1992-1994)

**Objectives:** In conjunction with the adult monitoring/research element determine distribution, abundance and movement of channel catfish

Determine food habits of potential squawfish predators (i.e. channel catfish) in suspected rearing areas and habitats.

In conjunction with early life history research and secondary channel research elements characterize relative abundance of non-native fishes in backwaters and secondary channels.

Determine food habits and food availability of native and nonnative fishes in backwaters and secondary channels and evaluate for dietary overlap.

Compare growth and survival of YOY and juvenile native fishes in backwater habitats with and without predators and/or competitors.

Develop flow recommendations that minimize non-native species survival and growth and do not negatively impact native species.

**Research Need:** Nonnative fish species have been implicated in the decline of native fishes of the Colorado River and other systems. The successful introduction and establishment of nonnative fishes in concert with habitat alteration has coincided with the decline in distribution and abundance of native species, in particular the Colorado squawfish and razorback sucker.

The effects of predation and competition by nonnative species on Colorado squawfish and other native species needs to be addressed in the San Juan River. In addition, the effect of flow on the nonnative species component of the fish fauna needs to be addressed to determine its usefulness as a potential management tool for controlling nonnative species. Preliminary research conducted during 1987-1990 indicated that flows were a possible factor controlling the abundance of nonnative species.

**Methods:**

During FY 92 studies addressing the first three objectives would be implemented. Channel catfish distribution and movement studies would be conducted in conjunction with other adult and juvenile fish sampling programs, using similar methods. Food habitats of potential non-native predators such as channel catfish would be assessed under differing flow regimes by taking stomach samples from fish collected during other study elements. In addition, stomach contents of museum specimens collected during 1987-1990 would be analyzed. In conjunction with other study element

sampling, nonnative fish communities in secondary channels and backwaters would be characterized using seines, electrofishing, nets and other applicable methods. Physical and chemical habitat at each sample location would be characterized along representative line transects.

#### CATEGORY - HABITAT FLOW RELATIONSHIPS

Status: Ongoing Core Research Program

Lead Agency: Bureau of Reclamation, Denver

Tasks: Analyze 1991 video data  
Conduct additional video imagery in FY 1992

Timeline: Phase I and II (FY 1991 thru 1994)

Objectives: Quantify habitat availability of specific habitat types at different flow levels.

Verify the accuracy and predictability of the flow to habitat relationship results

Research Need: Habitat availability at different flows is an important facet of the overall research plan which seeks to determine the biological response of target species to more "natural" flows in the San Juan River. Determination of habitat/flow relationships is integrally related to other ongoing research which deals with habitat use by target species. Riverine habitats must be quantified in order to determine the relationship between habitat availability, habitat use by target species and the impact of flows on target species.

Methods: Methods for collection and analysis of video imagery have been described in various technical reports. Briefly, video imagery is obtained from a helicopter using a Sony high resolution video camera attached to the nose of the aircraft. Imagery is collected at an altitude to insure bank to bank coverage in all frames. The video imagery is interpreted using MIPS (Map and Image Processing System), a PC based digitizing image software. Critical habitats and various riverine habitat components are enumerated and quantified.

During FY 1992 video data collected during 1991 will be interpreted using MIPS. A report will be

generated in early March that will include tabular data giving acreage and number by river mile for the following categories: backwaters, side channels, isolated pools, total open water.

Also in FY 92, the data acquisition schedule of the previous year will be repeated to verify the flow habitat relationships developed with the first year's field data. In addition, an attempt will be made to collect video imagery of winter habitat conditions.

#### **MEETINGS, REPORTS, AND DELIVERABLES**

Researchers will be responsible for submitting yearly progress reports for ongoing projects and a final report after completion of the study. A meeting will be scheduled on or about January 31st of each year to present an oral summary of progress to date. A written progress report summarizing results of research activities for the previous fiscal year will be due by March 1. Reclamation will also hold a meeting during March to determine flow releases from Navajo Dam for the upcoming season. Additional meetings will be scheduled as necessary to modify or refine research activities.

Upon the completion of Phase III a consolidated report will be prepared which brings together all the individual research studies. This report will summarize and integrate the various studies which have been conducted and make formal recommendations concerning management of endangered species in the San Juan River will be submitted by the combined research team. The U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service will be responsible for compiling the final consolidated report with input from all cooperating agencies.

#### **PROJECTED BUDGETS AND COMPLETION DATES**

The proposed level of funding by program and agency for Fiscal Year 1992 is given in Table 1. The total projected budget for FY 1992 is \$516,500. Funding requirements for ongoing programs are expected to remain constant during the remainder of Phase II (FY 1993 and 1994) and are anticipated to be approximately \$500,000 each year, assuming that large scale water quality monitoring programs will not be implemented and funded under the seven year research plan. In addition to funding provided by Reclamation the primary entities involved in research activities on the San Juan River are providing in-kind funding out of internal budgets. The USFWS, NMGF, and UDWR are contributing a total of approximately \$92,000 in man hours and equipment during FY92 to research activities being conducted under the seven year research plan. Table 2. summarizes the monetary equivalent of in-kind contributions by other government entities involved in the San Juan Seven Year Research Plan.

**TABLE 1. PROPOSED BUDGET FISCAL YEAR 1992 - SAN JUAN STUDIES**

RESEARCH PROGRAM	RECLAMATION				USFWS		NMGF	UDWR	CDOW
	UC Region	Denver	Bureau	Region-2	Region-4				
ADMINISTRATION	7500		1000	4850	11000	4000	3000		
Coordination	4000							2500	
Data Repository				4500					
ADULT MONITORING/TELEMETRY	6000		88500		51000	35500	6000		
EARLY LIFE STAGE	6000				11000	38000	65000		
SECONDARY CHANNEL	1000					26500	3500		
AUGMENTATION/TELEMETRY EXPERIMENT				8000					
TRIBUTARY SURVEYS						9500	6000		
TAILWATER STUDIES						18000			
Trout Populations						8000			
Water Quality						8000			
Angler Surveys						8000			
Physical Habitat	2000								
Trout Reproduction									
Macroinvertebrates	1000								
WATER QUALITY/CONTAMINANTS	2500								
NON-NATIVE				18350					
HABITAT/FLOW RELATIONSHIPS		55000							
AGENCY TOTAL	30,000	55,000	88,500	36,500	73,000	147,500	83,500	2,500	
GRAND TOTAL - FY 1992	516,500								

**TABLE 2. IN KIND CONTRIBUTIONS BY  
BY COOPERATING AGENCIES**

RESEARCH ACTIVITY	USFWS REGION 2 <sup>1</sup>		USFWS REGION 6		NADAP		UDWR	
	Personnel	Equipment/Travel	Personnel	Equipment/Travel	Personnel	Equipment/Travel	Personnel	Equipment/Travel
DATA MANAGEMENT	760							
ADULT MONITORING/TELEMETRY			2000 <sup>2</sup>	2000 <sup>2</sup>	18500	2000		
EARLY LIFE STAGE					2000		2260	3600
SECONDARY CHANNEL					12000	1500		
ALIGNMENT/TELEMETRY STUDY	4800	1000						
TRIBUTARY SURVEYS								
TAILWATER STUDIES					10000			
NON NATIVE RESEARCH	11800	2000						
COORDINATION/MEETINGS			10000 <sup>3</sup>				3000	
AGENCY TOTAL	16,800.00	3,000.00	17,000.00	2,600.00	39,500.00	4,500.00	5,360.00	3,600.00
<b>GRAND TOTAL</b>	<b>92,250.00</b>							

<sup>1</sup>FAO Office, Albuquerque, NM.

<sup>2</sup>Grand Junction Office

<sup>3</sup>SLC Office



Table 3. summarizes the projected timelines for ongoing programs and programs which will be initiated in FY 1992. Several research efforts such as the Secondary Channel and Tributary Survey are scheduled for completion at the end of Phase II in FY 1994. Other programs such as the Adult Monitoring/Telemetry and Augmentation research will be reevaluated in light of the objectives of the seven year research plan at the end of Phase II to determine if the information being collected is sufficient to warrant continuation of the program. Early Life Stage research is planned for the entirety of the seven year research period. Tailwater studies, non-native fish studies and water quality/contaminant studies will also be ongoing for the duration of the research period. Many of the tasks involved in the Tailwater studies, however, should be completed by the end of Phase II. Other research projects or programs will be implemented in Phase III based on Phase I and Phase II findings, and subject to scheduling and budget limitations.

**TABLE 3. PROJECTED TIMELINE FOR COMPLETION OF ONGOING AND PROPOSED  
SAN JUAN RIVER RESEARCH**

(program)	PHASE I	PHASE II			PHASE III		
	FY-1991	FY-1992	FY-1993	FY-1994	FY-1995	FY-1996	FY-1997
ADULT MONIT./TELEM.	*****	*****	*****	*****	-	-	-
EARLY LIFE STAGE	*****	*****	*****	*****	*****	*****	*****
SECONDARY CHANNEL	*****	*****	*****	*****			
AUGMENTATION		*****	*****	*****	-	-	-
TRIBUTARY SURVEYS		*****	*****	*****			
TAILWATER STUDIES		*****	*****	*****	*****	*****	*****
WATER QUALITY/CONTAM.		*****	*****	*****	*****	*****	*****
NON-NATIVE		*****	*****	*****	*****	*****	*****
HABITAT/FLOW	*****	*****	-	-			

#### LITERATURE CITED

Platania, S. P. 1990. Biological summary of the 1987 to 1989 New Mexico-Utah ichthyofaunal study of the San Juan River. Prepared under New Mexico Game and Fish Department Contract 78-516.6-01 and cooperative agreement 7-FC-40-05060 with U.S. Bureau of Reclamation, Salt Lake City, Utah.

Platania, S. P. (pers. communication). Personal communication with Dave Probst, New Mexico Game and Fish Department. 1991.

Sublette, J. E. 1977. A survey of the fishes of the San Juan River basin , with particular reference to the endangered species. Report submitted to the U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 95 pp.

VTN Consolidated, Inc. and Museum of Northern Arizona. 1978. Fish, wildlife, and habitat assessment; San Juan River, New Mexico and Utah. Gallup-Navajo Indian water supply project. VTN Consolidated, Inc., Irvine, California. 241 pp.

**ATTACHMENT A**  
**WORK STATEMENTS/PROTOCOLS**

## San Juan Seven Year Research Plan

### WORK STATEMENT/PROTOCOL

#### ADULT MONITORING - USFWS

##### Background:

Prior to 1987, irregular sampling efforts had documented a native San Juan River fish fauna of eight species and a possible ninth, including Colorado squawfish, razorback sucker, and roundtail chub. Although not confirmed in the literature, the ninth species (bonytail chub) was found to be a historic component of the fish fauna after reexamination of museum specimens (Platanía pers comm.). Surveys during 1987-1989 (Platanía 1990) confirmed the persistence of the Colorado squawfish, razorback sucker, and roundtail chub and provided some baseline information on the distribution and abundance of fish species in the San Juan River.

Despite confirmation of Colorado squawfish, razorback sucker, and roundtail chub in the San Juan River, there are important unanswered questions regarding the overall range, boundaries of primary ranges (residency or non-residency in the San Juan River), location of spawning and nursery habitats, and abundance of these species.

Research in other upper basin rivers of the Colorado River drainage and preliminary findings from studies conducted in the San Juan River in 1991 have shown that tracking radio-tagged fish can result in location of aggregations of the target species (particularly Colorado squawfish) during certain seasons and determination of spawning areas.

##### Objectives:

- 1.) Refine abundance and distribution data of the native and non-native fish community in the San Juan with emphasis on target species (Colorado squawfish, razorback sucker, and roundtail chub)
- 2.) Locate potential spawning areas of target species
- 3.) Determine habitat use and needs of target species

##### Tasks:

- 1.) Collect as many Colorado squawfish, razorback sucker, and chubs as possible for tagging, habitat, and distribution studies.
- 2.) PIT tag all adult Colorado squawfish and razorback sucker.
- 3.) Implant adult Colorado squawfish and razorback sucker collected with radio transmitters (up to 10 each).
- 4.) Collect tissues for genetic analysis. Muscle and fin tissue will be collected from all endangered fish for allozyme analysis. In addition, if the fish are ripe, gamete samples will be collected for mitochondrial DNA analysis. Region 6 Service fisheries personnel will be responsible for collection, labeling, storing, and shipping genetic samples. The protocol to be followed is attached.
- 5.) Collect data on habitat in which endangered fish were found. Mark collection sites of all endangered fish on aerial photographs. This should include precise locations, surface area of general habitat, substrate, depth, cover, and relation of this habitat to other habitats (riffles, pools, low-velocity areas, main and secondary channels, shore, etc.)

- 6.) Upon successful completion of implanting radio transmitters, the Service will organize tracking trips (with participation from cooperating agencies) to locate and monitor these fish.

**General Methods:**

Adult sampling efforts initiated in FY91 will continue through at least FY94. Three adult sampling trips are scheduled for each year, one in October, May, and June. All trips will go from the Hogback Diversion to either Bluff of Mexican Hat, with a minimum of one trip each year going as far down as Mexican Hat.

A variety of sampling techniques will be employed, including electrofishing, trammel netting, block and shock, drifting trammel nets, scare and snare etc. All fish observed during collection efforts will be captured if possible. All native fish will be released. Because the primary objective is to collect as many endangered fish as possible, the sampling crew will use individual judgment to determine sampling locations and sampling methodology. Lethal collections of target fish will be minimized.

Each adult target species fish will be PIT tagged, a radio transmitter implanted (up to a total of 20), tissues collected for genetic and contaminant analysis, weighed, measured, and released. Protocols for surgically implanting fish, and genetic sampling are included with this work statement.

Each trip will consist of a minimum of nine people:

- 2 - FWS Region 6
- 1 - FWS Region 2
- 2 - New Mexico
- 2 - Utah
- 2 - Bureau of Reclamation

In addition to the three sampling trips on the upper San Juan River, a similar effort will took place at the mouth of the San Juan below the existing natural barrier from May 25-June 8, 1991. This area will also be sampled in FY92. Kirk Lashmit (BR) will have the lead in this effort. A Region 6 fisheries person will be along to collect the genetic tissue.

### Protocol for Surgically Implanting Radio-transmitters

- 1.) Fish anesthetized with MS-222.
- 2.) Gills bathed with anesthetic while performing surgery.
- 3.) Fish covered with damp towels.
- 4.) Transmitter coated with bees wax.
- 5.) Transmitter and surgical tools sterilized with alcohol.
- 6.) Needle threaded with approx. 50 cm of suture material (ETHICON MONOFILAMENT)
- 7.) Incision area on fish sterilized with surgical scrub (Betadine).
- 8.) Incision made laterally, immediately anterior and slightly dorsal to insertion of right pelvic fin. About 1 to 1.5 inches in length and just deep enough to sever the peritoneal lining.
- 9.) Remove tag from alcohol and insert into peritoneal cavity with antenna pointing posteriorly.
- 10.) Incision closed with 5 to 8 individual sutures, tied with surgeons knot.
- 11.) Entire procedure should be completed in 5 to 7 minutes.
- 12.) Wound area covered with Betadine.
- 13.) Fish placed into recovery tank until fully recovered from anesthetic.
- 14.) Frequency of transmitter checked before and after implantation into fish.
- 15.) Fish released back to river.

**Endangered Fish Genetic Tissue Sampling Protocol**  
(San Juan 1991)

For allozyme analysis, two tissues will be taken from each Colorado squawfish and razorback sucker: a muscle plug and caudal fin tissue.

- 1.) All fish will be sampled non-lethally
- 2.) Anesthetize fish with appropriate concentration of MS-222
- 3.) Cover fish with wet towel(s) to protect from wind and sun
- 4.) One person takes tissue, another person labels vials (dry hands imperative) and records data
- 5.) Take tissue,

Use biopsy punches to cut and remove tissues. Scales do not have to be removed prior to punching. One punch per tissue sample. Tissue plug should be about 5 mm X 5 mm (or quarter inch by quarter inch). If tissue is not removed with punch, it may have to be snipped out with scissors and forceps. Keeping tissues clean, place into 1.5 mm snap-cap vials. Swab tissue removal site with Betadine. Clean and dry instruments between samples to avoid contamination of tissues. If data collection complete, recover fish and return to river.

- 6.) Label vials,

All important data cannot be placed on vial. coding is therefore required. A three character number will be written on the vial. The number will correspond to an individual fish. The number on the vial will correspond to the PIT-tag number of the fish. The PIT-tag number should then be recorded in the field notebook with other pertinent data. On each vial, a short series of letters will follow the number. The letter designations will correspond to species and tissues:

<u>Species</u>	<u>Tissue</u>
RB - razorback sucker	M - muscle
CS - Colorado squawfish	F - fin

Example: The team collects its' first razorback sucker. Muscle is placed in the first vial, which is labeled: 001RBM. fin is placed in the second vial, which is labeled: 001RBF. Label vials with permanent ink markers. The vial number and its associated tag number (xxxxxxxxxx) would be recorded in the field notebook.

- 7.) A standardized data sheet will be filled out completely at time of capture. information will include:

fish number, PIT tag number  
date collected  
tissue collected  
collectors name  
capture location, river miles  
fish length and weight  
ecological data: depth, velocity, substrate, water  
temperature



8.) Sample storage

Place vials with tissues, sequentially in vial racks, in ice chest, on dry ice as soon as possible. The main idea is to freeze them on dry ice and move them into an ultracold freezer as soon as possible. Once frozen, avoid thawing of tissues.

The attached protocol "PROCEDURE FOR COLLECTING TISSUES" is for collecting gametes to be used in mitochondrial DNA analysis.

Included therein is a protocol for taking tissues from dead fish. If fish is sent whole, put PIT-tag in dead fish, place label with pertinent data in mouth of dead fish (including PIT-tag number); wrap whole in aluminum foil, label, and freeze in dry ice as quickly as possible.

The Fish and Wildlife Service will be responsible for providing vials, markers, notebooks, punches, scissors, forceps, etc. needed for tissue collections.

#### PROCEDURE FOR COLLECTING GAMETES

1. Exude gametes into 15 ml Falcon sterile conical tubes with screw caps (Becton-Dickinson #4-2095-5; Fisher Scientific # 05-527-90) by applying gentle pressure to the flanks of the fish. Duplicate tubes would be nice, if possible. Be certain not to contaminate sample with water or dirt.
2. Tissues may be placed immediately on dry ice or stored on wet ice for a few days (maximum 4-6) until they can be flash-frozen (using dry ice). Note: these tubes become brittle when frozen at  $-80^{\circ}\text{C}$  and are more likely to crack. Be careful not to compress or physically abuse tubes when they are this cold, as it could cause them to shatter, spoiling the contents.
3. Store frozen tissues at  $-80^{\circ}\text{C}$  (preferred - may use dry ice if desired) or  $-20^{\circ}\text{C}$  (for short periods) prior to shipment. Be certain the tissues are not allowed to thaw. Thawing will result in degradation of DNA and substantial reductions in yields.
4. Ship tissues on dry ice by overnight air. Be certain to include enough dry ice to insure arrival without thawing (typically 5-10 lbs.)

#### PROCEDURE FOR COLLECTING TISSUES FROM DECEASED INDIVIDUALS

1. Source tissues for mtDNA for dissected specimens are (in order of best results): gonads, heart, liver, spleen, kidney, muscle. Dissect tissues (1-5 grams) and place in Falcon tubes (see above for catalog information) or small screw cap tubes (as for allozyme tissues). As above, duplicate tubes would be nice if the tissue is available.
2. Freeze dissected tissues immediately on dry ice or  $-20^{\circ}\text{C}$ . Once frozen they may be stored at  $-80^{\circ}\text{C}$  (or on dry ice) or  $-20^{\circ}\text{C}$  (for short periods).
3. Ship tissues on dry ice by overnight air. Be certain to include enough dry ice to insure arrival without thawing (typically 5-10 lbs.)

## San Juan Seven Year Research Plan

### WORK STATEMENT/PROTOCOL

#### ADULT MONITORING - RECLAMATION (Durango Project Office)

##### Background:

Colorado squawfish and razorback suckers have both been collected from the lower San Juan River and the San Juan arm of Lake Powell (Platanía, 1990). More specifically, one adult Colorado squawfish, collected from this arm of the lake in April 1987, was subsequently recaptured from the San Juan River in September of that year. This squawfish was the only one that was recaptured during a three year study period. This single recapture demonstrated that squawfish utilized habitat in both Lake Powell and the San Juan River. However, the duration and possible seasonal utilization of these habitats remain largely unknown.

Since 1987, the elevation of Lake Powell has steadily declined from 3698 feet to the current elevation of 3628 feet. During this period, extensive silt deposits have been exposed within the upper several miles of the San Juan arm of Lake Powell. These deposits have served to re-alter the original river channel resulting in the creation of a large vertical drop in the Piute Farms area. Significantly, this estimated 20 foot drop appears to be an impediment to the upstream movement of reservoir fish. Fish species that seasonally use the San Juan River would be expected to congregate at the base of this blockage, possibly including Colorado squawfish.

##### Objectives/Tasks:

Objectives and tasks for this effort would be essentially the same as those listed under the Adult Monitoring work statement for the USFWS.

##### General Methods:

The area of study would be confined to the extreme upper end of Lake Powell extending upstream in the San Juan River to Slickhorn Rapid. Principally, the focus of the field effort would be to collect adult Colorado squawfish for the implantation of radio transmitters; however, all rare or endangered fish species would be appropriately processed per existing protocols. Field data collections would begin in May, 1992.

##### Fisheries Collections

All electrofishing will be accomplished using a motorized 17 foot Jon Boat equipped with a Coffelt Model Variable Voltage Pulsator (VVP 15). The cathode will consist of four to six steel electrodes per boom depending on existing water conductivity. Pulsed direct current will be used exclusively. Electrofishing would be conducted during both the day and nighttime periods and on both sides of the river banks. Principally, the river section between the "waterfall" and the reservoir would be sampled using electrofishing exclusively, although some deeper water habitats would also be sampled with entanglement nets. The reservoir would be sampled using both gill and trammel nets. The length of nets will also vary, according to available nettable habitat, from 100 to 300 feet and the mesh size will vary from two to three inches. Since it may not be possible to launch the electrofishing boat upstream of the "waterfall", the river upstream of this point would be sampled utilizing seines and entanglement nets.

All fish captured will be identified and measured (TL). In addition, all rare or endangered fish will be weighed and will be PIT tagged. Adult Colorado squawfish over 500 mm in length (TL) will be surgically implanted with a radio transmitter using standardized methods. All of these implanted fish will be transported at least five miles upstream of the "waterfall" and released. The movements of these fish will be monitored daily for the duration of the sampling period.

### Physical Data Collections

All backwaters assessed to be permanent will be identified within the influence of the river. It is expected that most of these permanent backwaters were identified during the 1987 survey of this area; however, any newly created backwaters will be identified. In addition, that portion of the San Juan River that did not exist in 1987 will be characterized. Several profiles of the river will be done at representative locations on the river.

### Permits

A federal and state of Utah fish collection permit will be obtained allowing for the legal collection of both protected and non-protected fish species.

## San Juan Seven Year Research Plan

### WORK STATEMENT/PROTOCOL

#### EARLY LIFE STAGE RESEARCH - UDWR

##### Background:

This component of the research has been designed to characterize the early life stage of the ichthyofaunal community in the San Juan system. It is directed at specifically determining the annual relative abundance and distribution patterns of the larval stage of the target species over a seven year period. Research efforts have been divided into three major areas: 1) Larval Drift, 2) Larval Distribution, and 3) Over-winter Survival. Sampling begins in mid-June with simultaneous larval drift netting and intensive sampling of low velocity habitats. Platania (1990) estimated that Colorado squawfish spawned in the San Juan River during the months of July and August. Larval drift sampling and intensive sampling low velocity habitats concludes in mid-August. Fall (September) sampling characterizes the fish community in the low velocity habitats and represents the faunal conditions as the fish community prepares to over-winter. Those fish that over winter are sampled during the March sampling period.

Although these protocol have been written to answer specific questions on the San Juan River, much of the standardized sampling procedures draw heavily from existing protocols used currently on other Upper Basin rivers. The design is not intended to mimic those efforts, but rather to provide a method for comparison of data collected in the two areas.

##### Objectives:

- 1) To determine annual Colorado squawfish YOY recruitment (i.e., reproductive success) in relation to flow patterns in the San Juan River.
- 2) To identify timing and location of Colorado squawfish spawning in the San Juan River utilizing size and distribution of drifting larvae.
- 3) To characterize the early life stage ichthyofaunal community in low velocity habitats.
- 4) To estimate the relative influence of larval emigration on the squawfish population in the San Juan drainage.
- 5) To determine the relationship between over-winter survival and flow patterns in the San Juan River.

##### Methods:

###### Larval Drift

##### Sampling Protocol

Drifting larval fishes will be sampled with stationery nets at two locations on the San Juan River: 1. Below the Mancos/San Juan confluence in New Mexico (approx. RM 139) and 2. Mexican Hat, Utah (approx. RM 56). Drift nets will be similar to those used in the Upper Basin (0.5mm mesh equipped with flow meters). Drift net stations will be operated for six weeks from June 17 - July 26. At each of the two stations three nets will be fished on a daily basis during the pre-dawn/dawn hours with a target diel effort of three net-hours per station. Depending on the San Juan sediment/debris load it may be necessary to run the nets for two consecutive 0.5-hour runs to accrue this effort.

Nets should be set along an axis perpendicular to the shore, preferably on the margin of quiet shoreline habitats and a flowing channel. The drift nets equipped with steel rings attached to the mouth frame slide over steel posts

(rebar) pounded securely into the substrate. Ideally the nets should be submerged an inch or two below the water surface.

Subsequent to each morning's set, drift station personnel will sort through the accumulated debris and preserve all ichthyoplankton in 100% reagent grade ethyl alcohol. Data sheets will accommodate:

1. the following general information: date, river mile, weather condition, water temperature at start and pull times, collectors names; and
2. information specific to each net set: sample numbers, (each net set will receive a unique sample number, suggest starting with 92NM001 for the New Mexico station and 21UT001 for the Mexican Hat station), start time, pull time, sampling effort (minutes), flow meter reading at pull time, volume of H<sub>2</sub>O sampled, fish sampled (Y/N), NO. of bottles.

Following review of this protocol a data sheet will be drafted.

Each preserved sample (stored in Mason jars) will be accompanied by a 100% rag paper label (placed inside jar) with the following information: sample number, date, sample times (start-pull time), collectors initials, indication if there were multiple jars per sample (of\_). Sample number should be written with permanent marker on sample jar top.

Exact net set locations and duration of sets will vary throughout the six week sample period in order to accommodate changing river stage and abundance of drifting fish.

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**General Sampling Requirements:**

Drift Stations to be operated daily:  
Personnel / station:

June 15 - August 15  
(2) Bio-Aides

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**Larval Fish Distribution**

**Sampling Protocol:**

Conducted concurrently with the larval drift sampling (June 17 - July 26), will be three trips to sample (with seines) the San Juan River fish community in a variety of low velocity habitats. Each trip will start at the Hogback Diversion in New Mexico (RM 177.5) and terminate at or near Clay Hills Crossing (RM 2.5) upstream of Lake Powell. For sampling purposes the river will be sectioned into consecutive 5-mile reaches; one mile from each reach will be sampled (without replacement) during each sampling trip.

Within each sample-mile a variety of low velocity habitats (backwaters, pools, isolated pools, eddies, shorelines, etc.) should be seined; with a target number of four habitats per sample-mile. Two types of seines will be used: 1. 15'x 4' (1/16" mesh) which is of comparable dimension to those used on the Green and Colorado Rivers, and 2. a one-man, 1.0 m<sup>2</sup> (1/32" mesh). It is likely YOY target species present in the seined area will be collected with the 1/16" mesh seine. The purpose of the smaller 1/32" mesh seine is two fold: 1. more accurately characterize the fish community (may collect greater numbers of non-native cyprinid larvae, which may be too small to be effectively sampled with the larger mesh), and 2. to serve as verification that we are adequately sampling target species present. In each habitat two quantified passes will be made with each of the seines, area permitting. If a habitat is too small to accommodate hauls with both types of seines, the one-man seine should be used.

While in the field, the contents of all seine hauls should be searched for target species. Target species should be measured to the nearest millimeter Total Length (TL) and released. All other specimens will either be 1. identified and enumerated as adults or sub-adults, or 2. preserved in a 10% buffered formalin solution in WhirlPak containers (double-bagged). A sample label (100% rag paper)

will accompany the specimens, and the sample number, date, and San Juan River Mile will be inscribed with permanent marker on the outer bag.

All data collected at a habitat will be recorded on one data sheet. The following general habitat information will be collected: 1. Date, 2. Location (River Mile to nearest 0.1 mile), 3. Primary habitat type (Main Channel (MC) or Side Channel (SC), 4. Specific Habitat Type, 5. River Lt or RT, 6. MC Temp (°C), 7. Habitat Temp (°C), 8. Total Length of Habitat (meters), 9. Width (m) @mouth; and average width, 10. Max. Depth of Habitat, 11. Collectors (initials), 12. Landmarks (that might identify particular habitat on aerial photoimagery), 13. Sketch of habitat with and indication of seine haul locations.

The following seine haul information will be collected:

1. Sample NO. (suggested starting number: 91LV001), 2. Seine used: 1/16" or 1/32", 3. Time of haul, 4. Was haul across or parallel to axis of habitat, 5. Length of haul (meters), 6. Width of haul (meters), 7. Maximum depth (Dmax) (meters), 8. 1° and 2° Substrate type at Dmax, 9. Depth at a point half the distance from Dmax to shore (D<sub>1</sub>), 10. 1° and 2° Substrate type at D<sub>1</sub>, 11. Depth at a point half distance from Dmax to other shore (D<sub>2</sub>), 12. 1° and 2° Substrate type at D<sub>2</sub>, 13. Mud Depth (a measure of the degree of difficulty seining; 0-4, with 4 meaning to your nipples), 14. Fish Preserved (Y/N), 15. No. of Whirlpaks

Following review of this protocol a data sheet will be drafted.

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General Sampling Requirements:

No. of trips:	3
Duration of each trip:	8-9 days
No. of motorized rafts / trip	2 work boats
Personnel needed/trip	5

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OVER-WINTER SURVIVAL

Sampling Protocol

Over-winter survival of the early life stage of the target species will be determine by comparing relative densities in fall and spring samples. Sampling protocol closely follows that outlined for larval distribution. Fall and spring sampling will consist of one-trip of effort to characterize the fish community in low velocity habitats. All target species will have reached the juvenile stage and should be identifiable in the field. The sampling protocol for these trips will differ from the larval distribution element in the following manner:

1. Only fish caught in the first haul with the 1/16" mesh seine and the first haul with the 1/32" mesh seine will be enumerated from each habitat. The second hauls will be searched for target species only.

2. Sample numbers must be unique (suggested starting number: 91FS001).

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General Sampling Requirements:

No. of trips:	2
Duration of each trip:	8-9 days
No. of motorized rafts / trip	2
Personnel needed/trip	5

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## San Juan Seven Year Research Plan

### WORK STATEMENT/PROTOCOL

#### SECONDARY CHANNEL ICHTHYOFAUNAL CHARACTERIZATION - NMGF

##### Background:

The Primary study area for this research task is the San Juan River between Shiprock, New Mexico, and Bluff, Utah. Within this reach, the river is comprised of a primary channel and frequently one or more secondary channels. Secondary channels range in length from less than 300 m to more than 3 km. Volume of flow in secondary channels varies from less than 0.1 m<sup>3</sup>/sec to almost equal that of the primary channel. The extent of secondary channel habitat varies with river discharge, but even at low-summer flows some secondary channel habitat is present. Some secondary channels receive inflow from agricultural lands, groundwater seepage, and intermittent washes.

In the past 5 years, ichthyofaunal sampling has concentrated mainly upon primary channel and backwater habitats. cursory sampling revealed that fish communities of secondary channels are different, at least qualitatively, than those of the primary channel. Non-native fishes such as red shiner (Cyprinella lutrensis), fathead minnow (Pimephales promelas), and sunfishes (Centrarchidae) were more common in secondary than primary channels. Use of secondary channels by target species (Colorado squawfish, Ptychocheilus lucius, and roundtail chub, Gila robusta) was suspected but not confirmed until 1991 when a male Colorado squawfish was captured in a 3+ km secondary channel about 1.5 km upstream of its mouth.

Secondary channel habitats and their use by target species need to be quantified to determine the significance of these habitats for target species in the San Juan River.

##### Objectives:

The purpose of the Secondary Channel Ichthyofaunal Characterization Study is to document species present, their relative abundance, size range (=life stage), macro-habitat associations, and seasonal-use patterns.

##### Methods:

For the purposes of this research element, a secondary channel has been tentatively defined as one which is at least 300 m in length and has flow less than 30% of the primary channel. This definition is arbitrary and may be modified as field investigations progress. Secondary channels are herein classified as one of four types:

- Type I        = more than 1 km in length and less than 10% of total flow
- Type II       = more than 1 km in length and more than 10% of flow
- Type III      = less than 1 km in length and less than 10% of flow
- Type IV       = less than 1 km in length and more than 10% of flow.

The frequency of secondary channels varies between Shiprock and Bluff. If present, at least one will be sampled in each 8 km segment of the river. Two sampling efforts will be made in 1992; the first during spring run-off and the second in late summer.

In each Type I and II secondary channel sampled, fish collections, species habitat characterizations, and water quality measurements will be made at two sites. These sites will be located about one-fourth of secondary channel length from either end. One site, located about mid-channel length, will be sampled on



Type III and IV secondary channels.

Each sample site will be of sufficient length to include all macrohabitats (e.g., riffle, run, pool, backwater, etc.) within the channel. Fish will be collected primarily with seines. Where passive netting (e.g., trammel nets) is deemed more efficient, such will be used. Boat or backpack electrofishing gear will be used where this method is appropriate. The decision as to which collecting method is more appropriate will be made at the discretion of the field crew. Regardless of method, each will be quantified (i.e., area seined, duration of net-set, and elapsed shocking time).

At each site, collections will be separated by method and macrohabitat. Large specimens (> 150 mm total length) in each sub-collection will be identified, weighed, measured, and released (specimen release will be made in such a manner that subsequent sampling is not biased). All smaller specimens (except target species) will be preserved. All specimens retained will be identified and enumerated. Tissue samples will be taken from each target species (Colorado squawfish, roundtail chub, and razorback sucker) captured and each will be implanted with a PIT tag and radio transmitter (if feasible) according to established procedures.

Each macrohabitat will be characterized by dimensions (length, width, and depth), substrata, cover, and riparian vegetation. Dissolved oxygen, water and ambient temperature, salinity, conductivity, and pH will be measured at each site. Channel discharge will be estimated with a flow meter at each site. Each site will be located by river kilometer, with km 0 being the confluence of the San Juan and Colorado rivers, Utah (determined from pre-Lake Powell topographic maps) or to be compatible with river kilometer designations made for other research activities. Data will be recorded on standardized forms.

As currently envisioned, the study will entail 3 years of field work (1991-1993). An annual report summarizing the findings of each year's field work will be submitted in December. Modifications made in the research protocol and recommendations for changes will be included in the annual report. The final report will be submitted with 12 months of completion of the 1992 field season.

## San Juan Seven Year Research Plan

### WORK STATEMENT/PROTOCOL

#### AUGMENTATION/TELEMETRY RESEARCH - USFWS (Region-2)

##### Background:

A small and, as yet undefined population of Colorado squawfish inhabits the San Juan River from Lake Powell upstream to at least Shiprock, New Mexico. Studies during the period 1987-1990 (Platania 1990) have resulted the collection of eleven adults and nineteen young-of-year in this river reach. During subsequent sampling in June 1991 a total of four additional adult squawfish were collected in the reach between Four Corners and Shiprock. Three of these fish were implanted with radio transmitters. The fourth died of unknown causes. Since that time, weekly aerial reconnaissance flights and a single raft-mounted monitoring trip during August 1991 have been used to evaluate movement and habitat use of the radio-implanted squawfish. During the raft trip, attempts were made to collect other squawfish in the vicinity of radio contacts using trammel nets. Those attempts were unsuccessful.

Future efforts in regards to telemetry of Colorado squawfish in the San Juan River include continued collecting to capture, implant and release, and monitor movement and habitat use patterns of wild adults. Emphasis will be placed on collection efforts in areas where squawfish with active transmitters are present. Thus, successful collection of additional wild squawfish and recapture and radio replacement of currently implanted fish is needed to ensure continuation and completion of this portion of the San Juan Seven Year Research Plan.

The limited number of previous captures of Colorado squawfish in the San Juan River indicates that the potential exists to collect insufficient adult life history data. The probability that an adequate sample size of adult squawfish will be collected to continue and complete this study element is unknown. Based upon previous collection efforts, it is likely that low numbers of fish will continue to be encountered. However, the relatively new technique of "scare and snare" used to capture three of the four squawfish taken during June 1991 sampling may result in more Colorado squawfish captures.

In order to continue adult life history studies concerning movements and habitat use, it may be necessary to implant radio transmitters into hatchery-reared Colorado squawfish, if sufficient numbers of wild adults are not collected. Concerns exist regarding use of hatchery fish in wild conditions, particularly effects of hatchery fish on reproductive success of wild squawfish.

##### Objectives:

- 1) Determine if hatchery fish can be conditioned to enable rapid recovery and acclimation to natural stream conditions for radio telemetry research, and
- 2) Determine if hatchery fish can be physically altered to prevent successful reproduction to prevent potential genetic contamination of wild fish stocks in the river.

##### Methods:

###### Method Summary

Conditioning hatchery fish to current and live food can be accomplished via use of raceways and a diet of hatchery-reared fish. Rendering hatchery fish incapable of successfully spawning while not altering physiological and/or behavioral mechanisms would require physical alteration

Adult Colorado squawfish (1981 year class) spawned at Willow Beach National Fish

Hatchery (from the current Dexter NFH brood stock) and presently held at Dexter National Fish Hatchery and Technology Center will be used for this study segment. During fall 1991, experimental fish will have the posterior attachment sites for ovaries and testes severed and ends of gonads sutured, tied closed, and cauterized. Experimental and control fish will be held overwinter in a recirculating raceway system at Willow Beach NFH to provide current conditioning and fed live rainbow trout to simulate a more natural diet. Experimental fish will be anesthetized, gonads exposed and examined for condition (maturation) and physical status of previous surgery, and if incapable of reproducing, recovered and maintained in the raceway system for potential future use. Whether or not these experimental fish would be used for telemetry studies would be dependent upon the numbers of wild adult Colorado squawfish collected during fall 1991 and spring/summer 1992 in the San Juan River. The experimental fish will continue to be held at Willow Beach NFH in the manner described above for as long as a potential need exists.

#### Experimental Design- Colorado Squawfish Neutering

- I. Acquisition of experimental and control fish
  - Thirty 1981 year class held at DNFH transported to WBNFH October 1991
  - Fish separated into two raceways with current and fed a diet (amount to be determined) of live rainbow trout
  - Raceway system is two concrete raceways set in tandem with a recirculating pump on each end and adjusted so that flow is circulated from the upper end of raceway No. 1 to the lower end and pumped into raceway No. 2 where the water is pumped at the upper end of No. 2 into No. 1.
  - Rainbow trout are reared at the hatchery available on site for systematic feeding.
- A. Control fish
  - 12 fish total, 6 male and 6 female
  - placed in raceway No. 1
- B. Experimental fish
  - 12 fish total, 6 male and 6 female
  - placed in raceway No. 2
- C. Backup fish
  - 6 remaining fish held in separate raceway
- II. Holding/maintenance of fish
  - A. Establishment and maintenance of above described raceway system
  - B. Feeding
    - live hatchery-reared rainbow trout
    - feeding rate is \_\_\_\_ kg of trout/kg live weight of CSF
  - C. Fish held for 30 days in above system prior to surgery
- III. Physical data acquisition, Surgery
  - A. Length/weight data collected for all individuals
    - TL, SL, WEIGHT, EXTERNAL APPEARANCE
  - B. Surgery
    - anesthetize fish, follow identical surgery maintenance procedures as established for implanting radio transmitters
    - incision ventro-laterally from slightly anterior of pelvic girdle to near vent
    - sever ends of gonads from vent, suture closed and tie and/or suture

loose ends together (loop)  
- recovery (flowers, magazines, candy, etc.)

- C. Mortality
  - freeze specimen
  - use replacement fish from extra
  - perform surgery as above
- IV. Maintenance/Holding
  - A. Maintain current
    - pump replacement/maintenance
  - B. Feeding
    - per determined rate of \_\_\_\_ kg trout/kg body weight of CSF
  - C. Raceway maintenance
    - appropriate cleaning
    - screen maintenance
  - D. Water Quality
    - temperature regulation where appropriate (will depend upon ambient temperature effects on raceway temperatures, attempts to assimilate wild temperature regime)
    - water replacement to make up for evaporative/other losses
    - thermograph placement for duration of holding
    - monthly readings of D.O., Ph, conductivity, nutrients (N03)
- V. Post surgery examination, data acquisition
  - A. Timing Late May/Early June
    - based upon hatchery experiences but will be somewhat dependent upon raceway temperatures
  - B. Examination of experimental fish
    - anesthetize, perform same surgery as above to expose gonad ends
    - examine gonads for visibility (mature/maturing ovaries and tests)
    - examine former gonadal attachment sites near vent
    - external appearance, other comments
  - C. Recovery of control fish
    - recover and place back into raceway
    - maintain until use or nonuse decided
  - D. Examination of control fish
    - record individual fish TL, SL, WT
    - external appearance, other comments
- VI. Reporting
  - A. Data analysis, writeup, reporting
    - by August 31, 1991
  - B. Recommendations
    - Will it work if we need hatchery fish?

## VII. Experimental and Control Fish Disposition

- A. Maintenance until October 1992
  - results of collection efforts for wild fish
  - decision for use/nonuse
- B. Disposition if used
  - maintenance at WBNFH continued
  - radio implanting at WBNFH and transport to SJR
- C. Disposition if not used
  - retain experimental fish for specimens, preserve/freeze
  - control fish . . . return to broodstock or sacrifice

### Schedule

October 1991	Adult Colorado squawfish transported from Page Springs to Willow Beach
Nov./Dec. 1991	Surgically alter gonads
June 1992	Examine gonad condition, recover, hold
Oct. 1992 (or later)	Decision on use or further holding of fish

## San Juan Seven Year Research Plan

### WORK STATEMENT/PROTOCOL

#### TRIBUTARY ICHTHYOFAUNAL SURVEYS - NMGF, UDWR

##### Background:

The San Juan River has comparatively few perennial tributaries. Among these, the Los Pinos, Piedras, Navajo, Animas, La Plata, and Mancos rivers headwater in Colorado and New Mexico and are confluent with the San Juan River in New Mexico. Within Utah Recapture Creek, Montezuma Creek and Chinlee Wash are the major drainages feeding the San Juan. They, however, contribute little flow to the river. Discharge of tributary streams is variable seasonally and annually. The flow contribution of each to the San Juan River is likewise variable; ranging from less than 1.0 m<sup>3</sup>/sec to the Animas River, which is seasonally almost equal in discharge to that of the San Juan River. Three rivers (Los Pinos, Piedras, and Navajo) enter Navajo Reservoir and the remaining join the San Juan downstream of Navajo Reservoir. Tributaries downstream of the reservoir contribute to the restoration of a more natural, seasonally variable hydrograph in the San Juan River's lower reaches.

The historic fish community of each tributary is poorly documented, and is based primarily on reports in the 1890's by Jordan (1891). Several recent cursory inventories have been conducted on the Mancos River (Jensen, 1975; Robertson 1977) La Plata River (Smith 1976), and Animas River (Platania and Young 1990). Investigators have reported 17 native and non-native fish species occurring in one or more of these streams. The ichthyofauna of the Los Pinos, Piedras and Navajo rivers and Recapture Creek, Montezuma Creek and Chinlee wash are less well-known. None of these tributaries has been systematically inventoried to accurately define the species present, their longitudinal distribution or relative abundance.

Although use of tributary streams by target species has been suspected and in some cases documented, determination of the relative importance of these streams to target species is needed. The Animas River, for example may be important for maintenance of the roundtail chub population in the San Juan drainage. A detailed ichthyofaunal characterization of streams tributary to the San Juan river is essential to understanding the dynamics of mainstem San Juan River fish communities.

##### Objectives:

To determine fish species composition, distribution and relative abundance in the warmwater reaches of Los Pinos, Piedras, Navajo, Animas, La Plata, and Mancos rivers in New Mexico and Colorado, and Recapture Creek, Montezuma Creek, and Chinlee Wash in Utah.

##### Methods:

A series of sampling sites will be located at 3-5 kilometer intervals from the downstream terminus of each stream to upstream areas supporting only salmonids. Site placement and frequency will be somewhat dependant upon access. Where possible historic collection sites will be sampled.

Each study site will be of sufficient length (100-300 meters) to include all macrohabitat types (e.g. run, riffle, pool, glide) present within the general stream reach. Collection of specimens will be with electrofishing gear, trammel and gill nets, and seines. Specific sampling techniques used at a site will be at the discretion of the investigator and will depend upon habitats present and species likely to occur. Sampling will be segregated by macrohabitat type.

A species voucher collection of various sized specimens collected will be made for each sample site. In addition, specimens less than 150 mm that cannot be easily identified will be preserved for laboratory identification. Specimens

larger than 150 mm will be identified, weighed, measured, sexed if possible, and released. Collection effort will be recorded as elapsed shocking time, surface area seined, or elapsed time a passive net is set. Any target species captured will be weighed, measured, sexed (if possible), photographed, implanted with a PIT tag and/or radio tag (if feasible), and released. Tissue plugs from genetic analysis will be taken from each target species captured according to established protocols. Any target species mortalities will be immediately frozen on dry ice and shipped to the "U.S. Fish and Wildlife Service Fisheries Assistance office in Grand Junction, Colorado. The physical characteristics of each sampled macrohabitat will be measured and will include dimensions (mean depth and length), water velocity, and predominant substrate types. Other physical-chemical characteristics to be measured will include; water and ambient temperature, stream discharge, dissolved oxygen, conductivity, salinity and pH. Notes will also be taken on general habitat quality, riparian and aquatic vegetation and instream cover.

All specimens retained (excluding target species) will be processed and accessioned to the museum of Southwestern Biology, University of New Mexico. A summary of efforts, significant findings, and recommendations for future study will be submitted following completion of the first years field work. This study is envisioned as a two to three year field effort and will be completed as funding is available.



## San Juan Seven Year Research Plan

### WORK STATEMENT/PROTOCOL

#### NAVAJO DAM TAILWATER FISHERIES STUDIES - NMGP

##### TROUT POPULATION STUDIES

###### Background:

With the construction of Navajo Dam, the San Juan River from the outflow of Navajo Dam downstream to the U.S. Highway 64 bridge crossing at Blanco, New Mexico has been changed from a relatively warm, silt-laden stream inhabited mostly by native fishes to a cold, cobble-bottomed stream capable of supporting salmonids. Since the early 1960's, this portion of the San Juan has been managed as a trout water by the New Mexico Department of Game and Fish. The fishery is maintained mainly by stocking; however, some natural reproduction is evident. Much of the angling activity occurs above the confluence of the San Juan River and Gobernador Arroyo. Below this reach, trout habitat is often limited because of the accumulation of large amounts of sediment that enter the river from Gobernador, Pump, and Horse Canyon arroyos. During years of high releases, these areas are flushed of silt enabling them to support healthy populations of trout and thus increase the area used by anglers.

In the 3.75 mile section immediately below the dam, special bag and angling restrictions have been imposed. Coupled with the exceptionally good conditions for trout, restrictive regulations have helped to build this into one of the most popular angling waters in the western United States. Pressure count data estimates reveal that over 50,000 angler days a year are spent by anglers fishing the tailwater. Approximately 75 percent of these days are spent on these 3.75 miles of "Special Trout Water." Maintaining the quality of this valuable fishery is important both to the angler and the local economy. Because of this, studies are proposed which will examine the effects of experimental flows for Colorado squawfish on the trout fishery.

Some data are available on this fishery as the result of annual monitoring of the trout population in the Special Trout Water section of the river. These data, however, are insufficient to accurately quantify true response of the trout population to different water release schedules from Navajo Reservoir.

###### Objectives

Document the seasonal longitudinal distribution of salmonids in response to the various to different flow regimes

Determine the seasonal abundance of salmonid populations, and differential response of each salmonid species to various flow regimes. Changes in growth, condition, and survival of each species will be examined.

Determine if fish movements occur, especially during high flows, to help evaluate habitat needs associated with these flows.

###### Methods:

Methods proposed are tentative and may change after review of other tailwater studies. Two sampling efforts are proposed for 1992. The first will be just prior to the experimental releases in the spring and the second during the stable summer flows after the high-water release. Sampling will be done primarily by electrofishing. Data collection and analysis will be done by river mile beginning at the dam and continuing downstream to the bridge. For each river mile, all fish collected (including any native or non-salmonid species) will be identified, weighed, measured, marked for mark-and-recapture population estimation, and released. Scale samples will be taken from a representative subsample to estimate growth rates. The first 1,000 fish captured will be pit-

tagged. Information from the recapture of pit-tagged fish in subsequent years will help to verify growth information, survival estimates, and to analyze fish movement.

After the initial sampling, two additional electrofishing samples will be made to mark and recapture fish for population size estimation. During the first recapture collection, a tally of marked fish will be recorded and all unmarked fish will be marked (fin clip or similar) as on the previous sample. On the second recapture collection, all fish will be counted with a separate tally of marked fish that are recaptured. The rationale for using a multiple mark-and-recapture population estimate is to allow for enough recaptures to provide suitable confidence intervals. Because of the relatively large size of the stream, it may be difficult to adequately estimate the population size using a single recapture collection.

In addition to population studies, several fish will be radio tagged prior to the high-water releases. Their movements will be monitored throughout the period of the releases and holding locations will be characterized to determine habitat preference during high flows. Where practical, measurements will be made of stream depth and width, substrata, flow, dissolved oxygen, nitrogen saturation, and temperature.

As currently envisioned, the study will entail field work throughout the 7-year research period. Data obtained at different flows and changes in the fishery observed throughout the research period should provide a continuum to help determine suitable flows for the trout fishery. An annual report summarizing the findings of each year's field work will be submitted in December. Modifications made in the research protocol and recommendations for changes will be included in the annual report. The final report will be submitted within 12 months of the last field season.

#### **TAILWATERS INVESTIGATIONS-WATER QUALITY**

##### **Background:**

Changes in release patterns from reservoirs have been known to affect the quality of reservoir tailwaters. Releases in excess of 3,000 cfs from Navajo Dam have been documented to cause nitrogen supersaturation for some distance downstream in the San Juan River. During the first testing of the turbines owned by the City of Farmington hydroelectric plant at Navajo Dam, a large volume of silt was discharged into the river. Recent studies at Abiquiu Dam on the Chama River in north central New Mexico have shown low dissolved oxygen concentrations with high releases from the reservoir. Such changes in water quality are known to affect, often negatively, aquatic organisms, especially salmonids.

U. S. Geological Survey water quality data are available for the San Juan River at Archuleta, New Mexico. Although these data cover number of parameters, they are lacking for the purpose of determining short-term or temporary changes in water quality associated with changes in releases from the dam. Such changes could easily be missed in a single water sample taken only once a month. These short-term fluctuations may have a significant impact on the aquatic community. This ascertain changes associated with experimental releases for Colorado squawfish.

The purpose of this study is to identify any changes in water quality that might be associated with the operation of the dam to mimic the natural hydrograph. Observed changes in the water quality may or may not affect the tailwater fishery or the native fish community downstream. However, until changes are identified, it cannot be determined if they may be potentially detrimental to the aquatic biota

##### **Objectives:**

Characterize water quality of different flow releases from Navajo Dam and

determine its impact on tailwater fisheries.

#### Methods:

The study area will be that portion of the San Juan River beginning at the outflow of Navajo Dam to the U. S. Highway 64 bridge at Blanco, New Mexico. There will be five collection sites for water samples: immediately below the release of the dam; at the end of the "Special Trout Water" section of the river (3.75 miles downstream); at the Aztec (State Highway 173) bridge; at the State land section just downstream of the confluence of the San Juan and Pump Canyon Arroyo; and at the U. S. Highway 64 bridge at Blanco. The need for addition or deletion of sites will be determined as the results of the laboratory analyses samples are obtained.

A monthly water sample will be taken at each site. Additional samples will be taken at periods of changing flows while the dam is being operated to mimic the natural hydrograph. The samples will be sent to the Soil and Water Testing Laboratory at New Mexico State University or the State Laboratory Division in Albuquerque for analysis.

Each sample will be analyzed for total filterable residue (dissolved solids), turbidity (suspended solids), alkalinity (as  $\text{CaCO}_3$ ), carbonate, sulfate, nitrate, total hardness (as  $\text{CaCO}_3$ ), sodium, potassium, calcium, magnesium, iron manganese, total phosphorous, and total nitrogen. While collections are being made, on-site measurements of dissolved oxygen, temperature, conductivity, pH, salinity, and nitrogen saturation will also be made.

When nitrogen supersaturation levels are detected, additional measurements will be made at smaller distance intervals to determine how far downstream altered levels occur and how rapidly the nitrogen dissipates.

At the completion of the first year of sampling, a summary of findings will be submitted along with recommendations for further study. It is envisioned that 1-2 years of sampling will be sufficient for characterization of water quality during periods of lower flows. Subsequently, some additional sampling may be required during periods of high releases.

#### ANGLER USE AND CATCH SURVEYS

##### Background:

Estimates of angler use and catch rates are commonly used to measure the quality of fishing on a particular water. These types of data have been collected for several years as part of a Federal Aid in Fishery Restoration project on the San Juan River. Angler pressure counts on the river indicate that the fishery is increasing in popularity every year. Catch data indicate that a good-to-excellent catch rate is consistently provided by the fishery. The main factors contributing to the popularity of the fishery are probably the good-to-excellent catch rate and the large size of the fish. cursory examination of catch rates and angler use for the first two years following high water releases of 5,000 cfs in 1987 indicate a dramatic increase in both beginning soon after the return of lower flows of 600 cfs. This suggests that the catch rates and access to the river by wading was good at this time. During higher releases, Kelly (1984) found angler use to drop until low flows returned, probably as a result of decreased access to much of the river during higher flows.

This study intends to look for changes in angler use and catch rates throughout the period of experimental flows released for benefit and study of the squawfish. Decreases in angler use may indicate a negative impact on the fishery; and, likewise, increases will indicate no impact or a positive impact on the fishery. Changes in catch rates may give insight on why changes in angler use occur. Additionally, angler surveys can be examined with trout population study results

to determine the overall effect of flows on the fishery.

**Objectives:**

Determine the relationship between angler use and catch rates and flow releases from Navajo Dam.

**Methods:**

The study area will be that portion of the San Juan River beginning at the outflow of Navajo Dam and extending downstream to the U. S. Highway 64 bridge at Blanco, New Mexico.

Standardized pressure count and creel census forms similar to those previously used by the New Mexico Department of Game and Fish will be used (see attached). Data analysis will be consistent with that of previous Federal Aid studies so that a comparison can be made with previous studies. Pressure counts will be taken on at least two weekend days and four weekdays per month on specified reaches of the river. Angler interviews to obtain catch data will be taken one day per week for 52 weeks.

A summary of the results will be submitted in December following the research period. Over the seven-year study period, trends in angling pressure and catch rates will be evaluated in relation to various flows.

## San Juan Seven Year Research Plan

### WORK STATEMENT/PROTOCOL

#### WATER QUALITY PROGRAM - RECLAMATION (Salt Lake Regional Office)

##### Background:

A number of water quality investigations are ongoing or planned in the San Juan River Basin. The Department of Interior (DOI) has at least four major water quality programs ongoing in the San Juan River Basin. The Programs include three DOI National Irrigation Water Quality Programs:

- 1) Pine River phase II (nearing completion)
- 2) Navajo, Hammond, Fruitland projects (Navajo Dam to below Fruitland) in phase II to be completed in FY-1992.
- 3) Dolores Project which has return flow to the San Juan River and includes the San Juan from below Bloomfield to Lake Powell. This is also a phase II study scheduled for completion in FY-1992, and
- 4) the Bureau of Reclamation Colorado River Water Quality Improvement Program, San Juan River Unit Salinity Control Program. This study is scheduled for completion in FY-1992-93. (?)

In addition, the U.S.G.S. and EPA have a study of the fate of underground injection activities in the Aneth Oil Field Area of Utah.

Although only limited data is available from ongoing studies, preliminary information from the DOI National Irrigation Drainage Water Quality Program is indicating that potentially significant water quality problems may exist from numerous trace element sources and hydrocarbons in the San Juan River Basin.

Water quality issues in the San Juan River basin will need to be addressed in conjunction with other biological and habitat needs of the target species in the San Juan River if these species are to be conserved within the river.

##### Objectives:

- 1) Summarize water quality data available for the San Juan River.
- 2) Identify critical water quality issues which may affect recovery of endangered fish in the San Juan River.
- 3) Recommend additional research which is need to determine water quality impacts on endangered fish in the San Juan River.

##### Methods:

Water quality data from ongoing and historic studies in the San Juan will be summarized and analyzed in FY-1992. In addition, basic field water quality parameters such as temperature, conductivity and pH will be collected in conjunction with the biological and habitat studies which are planned for FY92. No permanent water quality monitoring sites will be implemented until there has been a thorough review of existing and ongoing water quality studies in the basin

The primary focus of the water quality program during FY92 will be to assemble the data from these various programs and assess its impact on the aquatic ecology of the San Juan River. The research program will also determine what future studies will be ongoing, and try to coordinate these efforts with the needs of the Seven Year Plan. For example, should the 2 studies on the San Juan River go to phase III (Detailed Investigation) level in FY-93-94, they could constitute a significant portion of the water quality program needs.

In addition, the Bureau of Reclamation and U.S. Fish and Wildlife Service will ask all the agencies with water quality monitoring and regulatory capabilities to form an interstate water quality council for the San Juan River. This will be an essential part of implementing water quality improvements on the San Juan River. Some of these regulatory programs need to begin immediately.

The San Juan water quality program will focus on the specific water quality impacts to fish, and critical habitat for endangered fish. These studies will determine what the future water quality condition will require in order to achieve a successful recovery.

## San Juan Seven Year Research Plan

### WORK STATEMENT/PROTOCOL

#### NON-NATIVE FISH RESEARCH

##### Background:

Nonnative fish species have been implicated in the decline of native fishes of the Colorado River and other systems. A combination of lab and field oriented studies has demonstrated resource overlap in diet and habitat use of native and nonnative species, predation on native species by nonnatives, and an apparent inferior competitiveness by native species when sympatric with nonnatives in selected habitats. The successful introduction and establishment of nonnative fishes in concert with habitat alteration (primarily flow related) has coincided with the decline in distribution and abundance of native species, in particular the Colorado squawfish and razorback sucker.

Research efforts in the San Juan River during 1987-1990 have documented the current distribution and abundance of fishes in the river below Navajo Dam and reservoir downstream to Lake Powell. During that period, a high flow year was followed by an apparent decline in the abundance of nonnative species. Subsequent low flow years coincided with an increase in nonnative fish numbers in backwater collections, implying greater survival of nonnatives and/or lower survival of natives. Potential nonnative predator species are few and dominated by channel catfish. Potential impacts of predation on native species has not been investigated on the San Juan River. Potential nonnative competitors include the red shiner and fathead minnow. Other than previously collected data on fish community structure in various habitat types, the role of common resource use by native and nonnative species in the San Juan River has not been investigated.

This segment of San Juan River fishery investigations will address the impacts of predation by nonnative predators and commonality in resource use between native and nonnative fish species under differing flow scenarios.

##### Objectives:

- 1) In conjunction with the adult monitoring/research element determine distribution, abundance and movement of channel catfish
- 2) Determine food habits of potential squawfish predators (i.e. channel catfish) in suspected rearing areas and habitats.
- 3) In conjunction with early life history research and secondary channel research elements characterize relative abundance of non-native fishes in backwaters and secondary channels.
- 4) Determine food habits and food availability of native and nonnative fishes in backwaters and secondary channels and evaluate for dietary overlap.
- 5) Compare growth and survival of YOY and juvenile native fishes in backwater habitats with and without predators and/or competitors.
- 6) Develop flow recommendations that minimize non-native species survival and growth and do no negatively impact native species.

##### Methods:

Task 1. Determine the distribution, abundance, and movement patterns of channel catfish and correlate to flow.

##### A. Methods

1. In conjunction with other adult and juvenile fish sampling,

collect by electrofishing, seining, and gill and trammel netting.

2. Record length/weight data, tag and release sub-adult and adult catfish, retain representative sample for other studies.
3. Enumerate young of year and juvenile catfish collected by seine from backwater and secondary channel habitats.

B. Schedule, 1992-1996 (three years: high, low, 3000-5000 cfs).

Jan-Feb: Selective juvenile and adult sampling in accessible habitats  
May-Jun: Adult sampling by electrofishing/netting  
Aug-Sep: YOY and juvenile sampling by seine  
Sep-Oct: Adult sampling by electrofishing/netting

Task 2. Determine the food habits of channel catfish under differing flow regimes in river reaches containing suspected juvenile squawfish rearing areas and juvenile squawfish collection localities.

A. Methods

1. During Task 1 sampling, preserve representative/ appropriate catfish samples for food habits analysis
2. Analyze stomach contents for food item frequency of occurrence and abundance.
3. Analyze stomach contents of museum specimens collected during 1987-1990

B. Schedule, 1992-1996 (three years: high, low, and 3000-5000 cfs flows)

Jan-Feb: Sample collection and processing  
May-Jun: " " " "  
Aug-Sep: " " " "  
Sep-Oct: " " " "

Task 3. Characterize fish species composition in backwater and secondary channel habitats and relate to habitat morphology and physical chemistry.

A. Methods

1. Collect fish by seining and electrofishing, record effort, enumerate, and preserve a representative subsample
2. Along transects measure depth, substrate, current velocity, and water transparency
3. Measure temperature, dissolved oxygen, and conductivity

B. Schedule, 1992-1996 (three years: high, low, 3000-5000 cfs flows).

Jan-Feb: fish sampling and habitat measurements  
Aug-Oct: " " " " "

Task 4. Determine the food habits of native and nonnative fishes in backwaters and secondary channels and evaluate for dietary overlap.

A. Methods

1. Collect fish by seine and preserve
2. Record habitat type
3. Record standard length and examine stomach contents of specimens of all native and dominate nonnative fish species
4. Summarize findings according to habitat type, species, and size



- B. Schedule, 1992-1996 (three years: high, low, 3000-5000 cfs flows)  
 Jan-Feb: fish sampling and sample processing  
 May-Jun: " " " "  
 Aug-Oct: " " " "

Task 5. Compare growth and survival of y-o-y and juvenile native fishes in backwater habitats with and without predators and/or competitors.

- A. Methods  
 1. Select experimental backwaters according to size, degree of protection from flood flows, and suitability for temporary barrier construction.  
 2. Erect temporary barriers at selected backwaters and from 1-2 backwaters each remove all nonnative predators and all nonnative predators and competitors  
 3. Select control (unaltered) backwaters for comparison  
 4. After barrier erection and fish removal, sample biweekly (or more often?) and record length/weight data and preserve subsample from each backwater  
 5. By snorkeling, observe native and nonnative species interactions in backwaters with adequate visibility to determine presence of interspecific aggression

- B. Schedule, 1993-1996 (two years, non-high flow)

Jul: select backwaters, barrier erection  
 Aug-Oct: biweekly sample fish in backwaters

Task 6. Identify the presence/absence and the characterization of habitats providing refuge for native fish species.

- A. Methods  
 1. Synthesize the results and interpretations of completed Tasks 1-5  
 2. Identify habitats, including type and ecological characterization, where collection and growth and survival of y-o-y and juvenile native fishes is greatest and least for nonnatives  
 3. Relate habitats identified in 2. to recent flow history  
 4. Identify flows that maximize the presence of native fish habitats which exclude nonnative fish

- B. Schedule, 1996-1997  
 Ongoing

**SAN JUAN RIVER SEVEN YEAR  
FISHERIES RESEARCH PLAN  
(Year 2 - Fiscal Year 1992)**

**INTRODUCTION**

Water resources in the western United States are being increasingly subjected to potentially conflicting uses. Water supply and power production needs have been considered the primary beneficial uses of water in the west during much of this century. In recent years, as a result of changing public attitudes and legislation, including the Endangered Species Act and the National Environmental Policy Act, maintenance of fish and wildlife both sport and native, and particularly endangered species has placed competing demands on water resources and has become an important issue in water development projects.

**BACKGROUND.** The San Juan River is a major tributary of the Colorado River in the upper basin of the Colorado River drainage. The river arises in the mountains of southwestern Colorado and exhibits several distinct geomorphic reaches as it traverses northwestern New Mexico and southeastern Utah before entering Lake Powell on the Colorado River. In its upper reaches in Colorado and the northern New Mexico, the river passes through rugged terrain, exhibits relatively high gradient with the flow generally restricted to a single channel. Approximately 50 kilometers of this section is inundated by Navajo reservoir. Near Archeluta, New Mexico, the river emerges from a canyon to meander across a broad floodplain. Between Archeluta and Shiprock, New Mexico, river gradient is relatively low and flow is generally restricted to one channel. Downstream of Shiprock, gradient remains relatively low but the river is frequently divided into several channels and permanent islands are common. This network of one or two main channels carrying the majority of flow and several smaller channels containing the remainder persists to Bluff, Utah. Downstream of Bluff, flow is generally restricted to a single channel and islands are less common. Near Mexican Hat, Utah, the river again enters canyon bound reaches and assumes a single channel with higher gradient until it reaches Lake Powell.

Major tributaries in the upper basin above Navajo reservoir include the Pinos, Piedras, and Navajo Rivers. Comparatively few tributaries enter the San Juan below the reservoir. The primary tributaries present in the 400 kilometers downstream of Navajo reservoir are the Animas, La Plata, and Mancos Rivers and McElmo, Montezuma and Chinle creeks. Numerous washes and arroyos also empty into the river, but none have permanent flow. The Animas River contributes more flow to the lower river than any other tributary. Prior to construction of Navajo reservoir, peak flows in the Animas river were almost equal in magnitude to San Juan River flows. Since the construction of Navajo reservoir which stores much of the spring runoff in the upper San Juan River, the

**ATTACHMENT B**  
**AGENCY BUDGETS**

**SAN JUAN SEVEN YEAR RESEARCH PLAN  
USFWS - REGION 6  
Proposed Budget FY92**

Personnel	
1 GM-13 Supervisor	\$ 5,000
1 GS-11/12 Fishery Biologist	25,000
1 GS-5 Biological Technician	9,500
1 GS-6 Secretarial/Administrative Support	<u>2,500</u>
Per Diem and Travel	16,000
Equipment and Supplies	<u>4,000</u>
Administration	<u>11,000</u>

**TOTAL PROPOSED BUDGET FY 1992 ..... \$73,000**

**SAN JUAN RIVER SEVEN YEAR RESEARCH PLAN**  
**USFWS REGION - 2**  
**Proposed Budget FY92**  
**(Non-native Species Interactions)**

**OBJECTIVE:** Initiate Tasks 1-3: 1) determine distribution, abundance, and movement of channel catfish, 2) determine food habits of channel catfish in suspected squawfish rearing areas and habitats, and 3) characterize relative abundance of native and nonnative species in backwaters and secondary channels.

<u>ITEM</u>	<u>COST</u>
Personnel: Biologist, GS 5, 1/2 FTE	\$10,000
Technician, GS 3, 1/4 FTE	3,500
Travel/Per Diem	2,500
Vehicle Use	1,250
Equipment Use	500
Supplies	<u>600</u>
Subtotal	18,350
Service Administrative Overhead - 17.65%	<u>3,240</u>
<b>TOTAL</b>	<b>\$21,590</b>
<b>REQUESTED</b>	<b>\$21,000</b>

**Proposed Budget FY92**  
**(Neutering of Hatchery Reared Colorado Squawfish)**

**OBJECTIVE:** Determine the feasibility of neutering hatchery reared Colorado squawfish and conditioning to current and live food in a recirculating raceway for potential use in San Juan River telemetry studies.

<u>ITEM</u>	<u>COST</u>
Personnel: Biologist, GS 5, 1/4 FTE	\$ 2,500
Travel/Per Diem	1,000
Vehicle Use (Fish transport)	500
Equipment Use (pump maintenance, electricity, etc.)	2,000
Supplies (lab, office, fish feed)	<u>2,000</u>
Subtotal	8,000
Service administrative overhead - 17.65%	<u>1,415</u>
<b>TOTAL</b>	<b>\$ 9,415</b>
<b>REQUESTED</b>	<b>\$ 9,500</b>

**Proposed Budget FY-92  
(Data Management)**

Personnel  
USFWS (OH)

\$ 4,500  
500

TOTAL  
REQUESTED

\$5,000  
\$5,000

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**TOTAL PROPOSED BUDGET FY92 USFWS REGION - 2**

**\$35,500**

**SAN JUAN RIVER ICHTHYOLOGICAL INVESTIGATIONS  
BUREAU OF RECLAMATION - DURANGO PROJECTS OFFICE  
PROPOSED BUDGET FISCAL YEAR 1992**

<u>Adult Monitoring</u>	
Personnel	\$65,000
Per Diem and Travel	5,500
Overtime	6,000
Equipment and Supplies	<u>12,000</u>

**TOTAL PROPOSED BUDGET FY 1992 ..... \$88,500**

SAN JUAN RIVER ICHTHYOLOGICAL INVESTIGATIONS  
NEW MEXICO DEPARTMENT OF FISH AND GAME  
PROPOSED BUDGET FISCAL YEAR 1992

<u>Adult Monitoring</u>	
Personnel	\$11,000
PerDiem and Travel	6,000
Telemetry Aircraft	16,000
Equipment and Supplies	<u>2,500</u>
<u>Larval and YOY Sampling<sup>1</sup></u>	29,000
Personnel	<del>\$31,000</del>
Per Diem and Travel	3,000
Equipment and Supplies	<u>4,000</u>
<u>Secondary Channel<sup>2</sup></u>	\$21,000
Personnel	2,500
Per Diem and Travel	<u>3,000</u>
Equipment and Supplies	
<u>Tributaries Ichthyofaunal Survey<sup>3</sup></u>	\$ 5,000
Personnel	1,500
Per Diem and Travel	<u>2,500</u>
Equipment and Supplies	
<u>Trout Population Studies<sup>4</sup></u>	\$12,000
Personnel	1,000
Per Diem and Travel	<u>5,000</u>
Equipment and Supplies	
<u>Water Quality Characterization<sup>5</sup></u>	\$ 2,000
Personnel	5,000
Laboratory Analyses	0
Per Diem and Travel	<u>1,000</u>
Equipment and Supplies	
<u>Angler Use and Catch Survey<sup>6</sup></u>	\$ 6,500
Personnel	1,500
Per Diem and Travel	<u>0</u>
Equipment and Supplies	
<u>NMCF Administration</u>	\$ 0
Personnel	<u>4,000</u>
Per Diem and Travel	
<u>Budget Summary</u>	\$26,500
Secondary Channel	35,500
Adult Monitoring	38,000
Larval and YOY Sampling	9,500
Tributary Inventory	34,000
Tailwater Fishery Studies	<u>4,000</u>
Administration	

**TOTAL PROPOSED BUDGET FY 1992<sup>5</sup>.....\$147,500**

<sup>1</sup>Includes larval fish identification and curation

<sup>2</sup>NMCF lead

<sup>3</sup>Includes NM and CO tributaries

<sup>4</sup>Tailwater Fisheries Studies

<sup>5</sup>Does not include tailwater studies to be contracted



**SAN JUAN RIVER SEVEN YEAR RESEARCH PLAN  
UTAH DIVISION OF WILDLIFE RESOURCES  
Proposed Budget FY-92**

<u>Adult Monitoring</u>	
Personnel	\$ 4,000.00
Per Diem and Travel	1,500.00
Equipment and Supplies	<u>500.00</u>
<u>Early Life Stage:<sup>1</sup></u>	
<u>Larval Drift</u>	
Personnel	\$10,000.00
Per Diem and Travel	5,000.00
Equipment and Supplies	<u>4,000.00</u>
<u>Larval Distribution</u>	
Personnel	\$21,500.00
Per Diem and Travel	3,000.00
Equipment and Supplies	<u>7,000.00</u>
<u>Over-Winter Survival</u>	
Personnel	\$10,500.00
Per Diem and Travel	2,000.00
Equipment and Supplies	<u>2,000.00</u>
<u>Secondary Channel</u>	
Personnel	\$ 1,750.00
Per Diem and Travel	1,300.00
Equipment and Supplies	<u>350.00</u>
<u>Tributaries Ichthyofaunal Survey</u>	
Personnel	\$ 5,000.00
Per Diem and Travel	<u>1,000.00</u>
<u>UDWR Administration</u>	
Personnel	\$ 0.00
Per Diem and Travel	2,500.00
Equipment and Supplies	<u>500.00</u>
<u>Budget Summary</u>	
Adult Monitoring	\$ 6,000.00
Early Life Stage Sampling	65,000.00
Secondary Channel	3,500.00
Tributary Inventory	6,000.00
Administration	<u>3,000.00</u>

**TOTAL PROPOSED BUDGET FY 1992.....\$ 83,500**

<sup>1</sup>UDWR Lead

**SAN JUAN RIVER SEVEN YEAR PLAN  
COLORADO DIVISION OF WILDLIFE  
Proposed Budget FY92**

Personnel	\$ 1,500
Per Diem and Travel	<u>1,000</u>
<b>TOTAL PROPOSED BUDGET FY92</b>	<b><u>\$2,500</u></b>